# Drivers of cash use - theory and evidence

Jenna Maria Björklund

University of Helsinki

Faculty of Social Sciences

Economics

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HELSINGIN YLIOPISTO
HELSINGFORS UNIVERSITET
UNIVERSITY OF HELSINKI

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Jenna Björklund

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Tiivistelmä – Referat – Abstract

There has been a lot of discussion on the downsides of cash during the 2010's, while the new payment innovations during this same decade have provoked speculation that cash use will decrease considerably, potentially even disappear, in the upcoming years. However, cash is still used quite extensively, and to my knowledge, no systematic review on drivers of cash use has been made to date. The purpose of this thesis is to fill this gap by providing literature reviews both on the theory explaining cash use and the empirical evidence on the drivers of cash use. Additionally, Finland will be used as an illustration to study the relevance of the existing theories and empirical evidence in an environment where practically no barriers on switching completely from cash use to card use exist.

The theoretical models explaining the choice between cash and cards at points of sale are built on assumptions that the pecuniary and/or non-pecuniary costs of cash and cards use differ. Particularly, cards are assumed to be more expensive than cash in some regard, which explains the cash choice. Behaviour wise, cash use is associated with lower transaction value, lower income, higher amounts of cash in the wallet and using cash to monitor liquidity.

In empirical literature, factors that affect the payment instrument choice at point of sale are traditionally divided into four categories: payment instrument attributes, transaction specific characteristics, demographic factors and habit. Three out of the four theoretical models presented in this thesis seem relevant in explaining cash use in the view of the empirical evidence, although alternative explanations for the observed behaviour can also be found. Also, several other drivers of cash use are identified. Additionally, as making payments is a very frequent action, it is suggested that habit might have a bigger role in the payment instrument choice than is traditionally assumed, with several of the drivers being potentially a manifestation of habitual behaviour. A considerable limitation of the existing literature is that it focuses solely on explaining and analysing cash use for transaction purposes at points of sale. However, cash is also used for person-to-person transactions and as a store of value, and the reasons for cash use probably differ a lot in these other two use cases.

Due to well-developed infrastructure, and cheap and fast card payments, many of the drivers of cash use identified by theoretical models and empirical evidence cannot explain cash use in Finland. In 2016 Finnish people used cash to pay small transactions, to control spending, because they perceived it to be easy to use, when they obtained it from another person or out of habit. Due to the quickly growing popularity of contactless card payments and the mobile phone applications for making easy person-to-person transactions, it is likely, that in future cash will decrease remarkably and it is mainly driven by the need to control spending, difficulty in using electronic payment instruments and habit.

Avainsanat – Nyckelord – Keywords
Cash
Payments
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Tiivistelmä – Referat – Abstract

Käteisen haittapuolista on käyty paljon keskustelua 2010-luvulla. Samaan aikaan monet uudet maksuinnovaatiot ovat aiheuttaneet spekulaatiota siitä, että käteisen käyttö tulee vähenemään huomattavasti, tai jopa loppumaan kokonaan lähitulevaisuudessa. Käteistä kuitenkin käytetään edelleenkin melko paljon, eikä yhtään systemaattista katsausta käteisen käytön syistä ole tietääkseni tähän mennessä tehty. Tämän tutkielman tavoitteena on täyttää tämä tutkimusaukko tarjoamalla kirjallisuuskatsaus sekä teoreettisista, käteisen käyttöä selittävistä malleista että empiirisissä, käteisen käyttöä analysoivissa tutkimuksissa esitetyistä käteisen käytön selittäjistä. Lisäksi tässä tutkitaan esitettyjen mallien ja empiiristen tutkimustulosten relevanttiutta ympäristössä, jossa ei ole mitään käytännön estettä siirtyä käteisestä pelkkiin korttimaksuihin. Tähän käytetään esimerkkinä Suomen tapausta.

Teoreettiset, maksutavan valintaa kaupan kassalla selittävät mallit rakentuvat oletuksille, että raha- ja/tai muut käteiseen ja korttiin liittyvät kustannukset ovat käteiselle ja kortille erit. Erityisesti, korttien oletetaan olevan jossakin tilanteissa käteistä kalliimpia, ja näissä tilanteissa maksutavaksi valitaan käteinen. Käyttäytymismielessä käteisen käyttö yhdistetään pieniin maksuihin, alhaiseen tulotasoon, suurempaan käteisen määrään kukkarossa sekä tarpeeseen tarkkailla menoja.

Empiirisessä kirjallisuudessa maksutavan valintaan vaikuttavat tekijät on perinteisesti jaoteltu neljään luokkaan: maksuinstrumenttien ominaisuuksiin, transaktiokohtaisiin tekijöihin, demografisiin tekijöihin ja tapaan. Kolme neljästä tutkielmassa eitetystä teoreettisesta mallista vaikuttavat empiiristen tulosten valossa relevanteilta maksutavan valinnan selittäjiltä, tosin vaihtoehtoisiakin selityksiä havaitulle käytökselle löydetään. Myös useita muita käteisen käytön selittäjiä identifioidaan. Lisäksi, koska maksujen tekeminen on usein toistuva toiminto, on mahdollista, että tavalla on paljon suurempi vaikutus maksutavan valintaan kuin mitä perinteisesti on ajateltu, ja moni selittäjä saattaakin olla kuvastaa itse tapaan perustuvaa käytöstä. Eräs suuri olemassa olevan kirjallisuuden puute on se, että se keskittyy vain selittämään ja analysoimaan miksi käteistä käytetään kaupan kassalla. Käteistä kuitenkin käytetään myös yksityishenkilöltä toiselle yksityishenkilölle tehdyissä transaktioissa sekä arvon säilyttäjänä, ja näissä käyttötapauksissa käteisen käytön syyt todennäköisesti eroavat niistä syistä, joista käteistä käytetään kaupan kassalla.

Pitkälle kehittyneen maksuinfrastruktuurin sekä halpojen ja nopeiden korttimakujen vuoksi moni teoreettisessa ja empiirisessä kirjallisuudessa identifioiduista käteisen käytön syistä ei päde Suomessa. Vuonna 2016 suomalaiset käyttivät käteistä pieniin maksuihin, kontrolloimaan kulutusta, koska he kokivat käteisen helpoksi maksutavaksi, pelkästä tavasta, tai silloin kuin saivat käteistä toiselta yksityishenkilöltä. Nopeasti suosiota kasvattava lähimaksu sekä kännykkä-sovellukset henkilöltä toiselle tehtävien rahasiirtojen tekemiseen johtavat todennäköisesti siihen, että käteisen käyttö vähenee huomattavasti, ja sitä käyttävät lähinnä ne, joilla on tarve kontrolloida kulutusta, tai jotka kokevat elektronisten maksutapojen käytön hankalaksi, sekä ne, jotka käyttävät käteistä tavasta.

Avainsanat – Nyckelord – Keywords
Käteinen
Maksaminen
Maksutavan valinta

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# 1. Introduction

The role of cash in contemporary societies has attracted a great deal of attention in mid 2010's, with most of discussion revolving around the downsides of cash. Cash has, for example, been reported to be dirty (Doucleff, 2014) impractical (Lieber, 2012) and obsolete (Reuters, 2016). Cash, and especially high denomination bills, have also been criticized for facilitating tax evasion, terrorist financing, money laundering, and corruption (Sands et. al., 2016; Rogoff, 2014). These concerns did not go unnoticed either: in May 2016, the European Central Bank announced that it will discontinue the production and issuance of the 500€ note due to concerns that it is facilitating illegal activities (ECB, 2016). In media the decision to stop printing the 500€ note has also been linked to motives related to monetary policy (Ewing, 2016; Hurri, 2016; Ahmed, 2016). With no 500€ notes, storing money in the form of cash would become considerably more expensive which, in turn, would allow the ECB to push the interest rates on overnight deposits further below zero without banks finding it more profitable to switch central bank deposits to cash (Rogoff and Fuest, 2016). The problem of zero lower bound, i.e. the situation where the central bank would like to lower the short-term nominal interest rate but cannot push it (much) below zero due to consumers and banks switching to cash if the interest rate became too negative, has raised discussion on the potentials of a cashless economy. For example, Kenneth Rogoff, a Harvard economist, and Andrew Haldane, the chief economist of Bank of England, have floated the idea of replacing cash with a central bank-issued digital currency that would allow for levying negative interest rates (Rogoff, 2014; Haldane, 2015). The idea has attracted attention of some central banks. The Bank of England and the Bank of Canada, for example, are exploring what a central bank-issued digital currency could mean (Bank of England, 2015; Fung and Halaburda, 2016). In addition to facilitating unwanted economic activity and preventing the central banks from implementing the monetary policy they want, cash has gained reputation as being expensive. It has repeatedly been shown that debit cards are socially, i.e. in terms of resource costs, more cost efficient than cash for higher value payments, with the threshold transaction value after which debit card payments become more efficient

than cash payments ranging between 2€ and 14€ (see for example Jonker, 2013; Stewart et. al., 2014). Consumers have been slow to switch from cash to cards to the desired degree suggested by the cost studies on their own initiative, which has lead to campaigns aiming at encouraging people to use more debit cards at the expense of cash (Van der Cruijsen, Hernandez and Jonker, 2017).

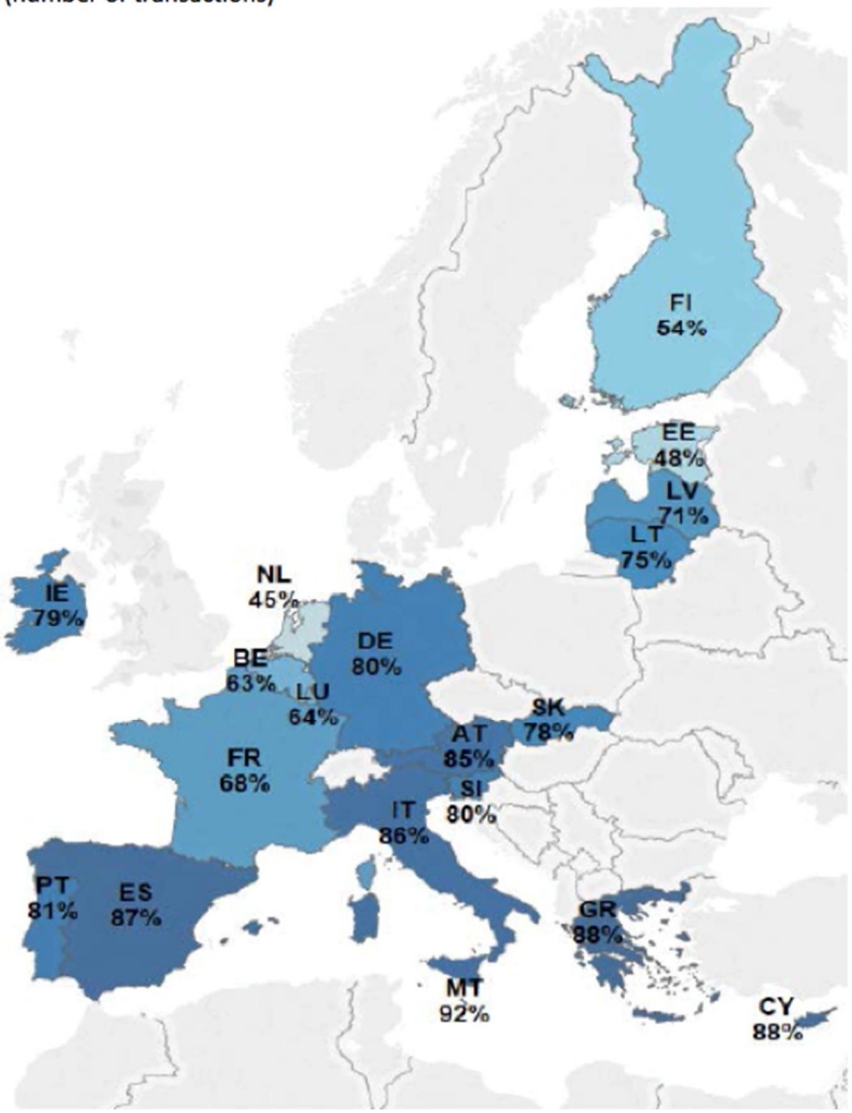
Despite all this worry on the negative externalities and relative social cost efficiency of cash, and despite some considering cash as old fashioned and impractical, it is still used, even quite widely in many countries. For example, an extensive study by the European Central Bank on the use of cash in the euro area countries in 2016[1] shows that in terms of the number of transactions, almost 79% of all transactions in the euro area made at points of sale were paid using cash, with the share of cash payments varying between 45 and 92 per cent by country (see Figure 1) (Esselink and Hernández, 2017). Similarly, a cost study from Canada shows that Canadians made approximately 44 per cent of their transactions at points of sale with cash in 2013 (Kosse et. al., 2016). For a more balanced view on the role of cash in the society it would be important to understand the consumers point of view. Hence, the first research question in my thesis is, according to the theoretical and empirical literature, why is cash used and by whom?

To my knowledge, there are no previous literature reviews on theories of payment instrument choice, nor are there reviews focusing on what is empirically known about why people use cash. Therefore, my objective is to give a general introduction on these two strands of literature. I will start by introducing models that have addressed the consumer payment instrument choice, by examining what determines the choice according to each model, what are the crucial assumptions, and what is the predicted behaviour. After this, I will examine what is known about drivers of cash use in the empirical payment instrument choice literature. The analysis will be descriptive in nature, the aim being to give an overview of what type of factors are commonly associated with cash use, and what type of problems arise in comparing and interpreting the results from the different studies. To analyse the relevance of the

[1] The data for Germany is from 2014.

models I will examine whether the assumptions and predicted behaviour is supported by empirical evidence.

Figure 1. Share of cash transactions per country at points of sale (number of transactions)




Source: The use of cash by households in the euro area (Esselink and Hernández, 2017).

With new retail payment innovations such as NFC-technology based contactless payment cards and mobile payment applications for person-to-person payments, the payment market is changing fast. The Nordic countries are forerunners in electronic payments, which makes them interesting examples to study in terms of cash use: with basically no barriers for using electronic payment instruments, and cash and cards

being seemingly equally costly, what is driving people to use cash? Additionally, can these forerunners provide some insight into understanding how the new innovations might affect the payment behaviour in the near future? I will use Finland as an illustration to study the relevance of existing theories and empirical results in explaining the consumer payment instrument choice in this type of environment. To do this, I will use available data on the cost structure of the Finnish retail payments market to check whether the model assumptions hold. As there is no information on transaction times of cash and cards - a factor often considered to affect the payment instrument choice - I will conduct a transaction time study to check which instrument is faster in Finland. Additionally, I will use a cash survey from 2016 conducted by the Bank of Finland to check whether the stated reasons to use cash in Finland are in line with the results of the existing empirical studies on payment instrument choice. I will conclude by analysing the Finnish results in light of the new payment instrument innovations to speculate on the potential drivers of cash use in future.

I will start by presenting some relevant background information on cash and cash use. Section 3 focuses on theories of payment instrument choice while section 4 presents the findings of the empirical literature on the drivers of cash use. Section 5 analyses the drivers of cash use in Finland and section 6 concludes.

## 2. Background

In his book The General Theory of Employment, Interest and Money (1936), Keynes distinguished between three distinctive motives to hold money, namely, a transaction motive, a precautionary motive and a speculative motive. The transaction motive refers to the need to hold money to make regular, known payments, whereas the precautionary motive refers to the need to hold money for unplanned payments. The speculative motive refers to holding money (instead of securities) as a store of value. In general, the money supply consists of different type of money depending on the measure used (M0, M1, M2 etc.). In the Keynesian framework, money refers to forms of money that can be used for transaction purposes, which, in his time, meant cash. The present-day equivalent for this definition of money would be not only cash but also different type of electronic money, such as money on checking accounts (digital money on highly liquid bank accounts) or e-money (monetary value stored on technical devices acting as prepaid bearer instruments that can be used for making payments (European Central Bank (a))). Also cryptocurrencies such as Bitcoin could potentially be considered as electronic money. However, as economists define money as a verifiable asset that serves as a medium of exchange, a unit of account and a store of value, and cryptocurrencies fail all three of these functions as they are poorly accepted as a medium of exchange, not accepted as a unit of account and too volatile in their value to be used as a store of value, the ECB considers them as assets rather than as money (Mersch, 2018). Cash can be held for all the same motives as money in general. To understand what drives cash use, it is important to distinguish between the motives of cash use and the contexts where the choice is made. This is because the context and motive define the alternatives for cash (see Figure 2), and to make a choice, the consumer will have to consider costs and benefits related to different alternatives.

For the store of value purpose, cash competes with electronic money - mainly money on checking accounts - and securities. For the transaction purpose, the alternatives depend on the context the transaction is made at. Cash can be used both for payments

made at points of sale (POS transactions) and for transactions that are made from one person to another person (P2P transactions).

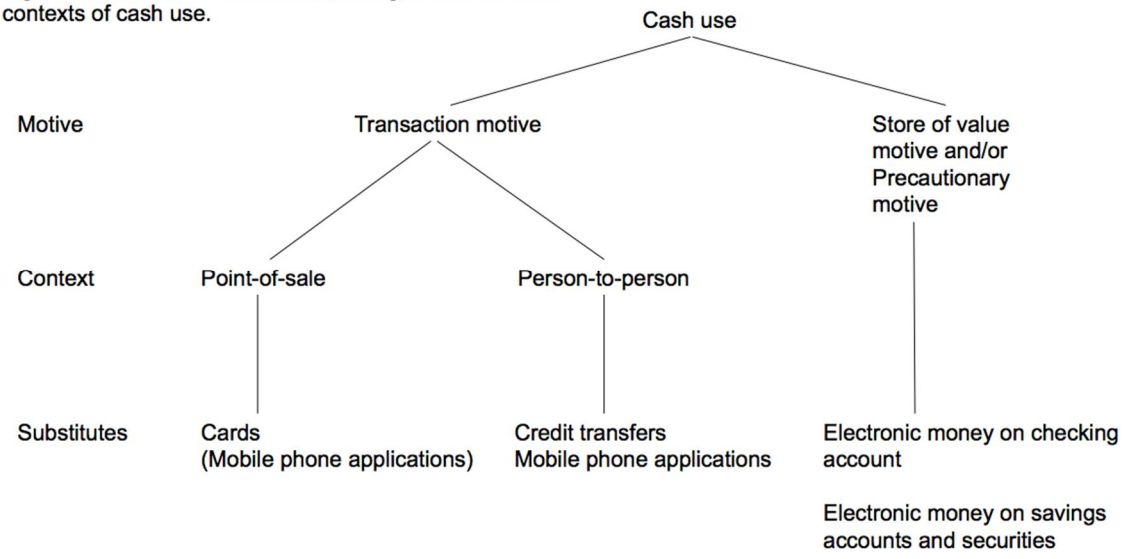
For POS transactions the substitutes traditionally most commonly used are debit and credit cards, and cheques (instruments to withdraw on checking accounts) or prepaid cards (e-money). Newer payment instruments, such as mobile phone applications for making payments at POS also exist in some countries. Depending on the underlying technology the transactions might be made either using bank account money or e-money. As mentioned above, some consider cryptoassets such as Bitcoin as a payment instrument but as their acceptance at points of sale is extremely limited, they cannot be considered as a relevant alternative to make POS payments with.

For P2P transactions, the most common substitutes for cash have traditionally been credit transfers initiated using Internet banking services or cheques, depending on the country. In the last few years, mobile phone applications for sending money to other persons have also become very popular in a number of countries, including Finland. Due to low acceptance and high volatility in their valuation, cryptoassets do not seem as a relevant substitute for these existing P2P instruments when the payer and payee are located within the same country. Although in certain situations cryptoassets might be a relatively convenient instrument to make international P2P transactions with, they are not really an alternative for cash in this regard, as cash is an instrument used for face-to-face transactions and thus rarely used for international transactions (instruments such as money transfers are more likely to be used than sending actual bills by mail). So, as the focus is on alternatives for cash and if cash is not used for remote (international) P2P transactions the potential usefulness of cryptocurrencies for this purpose is irrelevant as they are not an alternative for cash but for credit transfers and money remittances.

Although theoretically the precautionary motive for money demand falls somewhere between the transaction motive and the store of value motive, when considering the demand for cash for precautionary motives, the substitute for cash would be electronic money, such as money on checking accounts or e-money, assuming that the

unplanned payments have to be paid immediately. Therefore, these two motives - transaction motive and precautionary motive - are treated as one in this thesis.

Figure 2. Alternatives for cash according to motives and contexts of cash use.




Interestingly, there are theories modelling the choice between cash and cards at point of sale but, to my knowledge, there exists no theories modelling the choice of payment instrument when making person-to-person transactions, nor are there theories modelling the choice between cash and money on a checking account for store of value or precautionary purposes.[2] Similarly, also the empirical literature focuses on the payment instrument choice at points of sale, while, to my knowledge, no studies on cash use for person-to-person transactions or cash use for store of value purposes have been made. However, it could be that in countries with a very developed card infrastructure and stable banking system - as is the case in the Nordic countries - cash use at POS is limited, cash use for store of value purposes is insignificant, but cash use for P2P transactions might be very common, leading to cash use for P2P transactions constituting a great share of the total cash use. Alternatively, in some countries cash

[2] There are theories modelling the choice between money and securities for speculative motives (see for example Beaumol 1952, and Tobin 1956)), but they don't differentiate between cash and money on checking account. Therefore, theoretically it is not clear why people would choose to keep precautionary cash reserves or store value in cash form instead of keeping the money on a checking account, especially as cash bears no interest and it can be stolen.

might be commonly used for store of value purposes. Therefore, to gain a comprehensive understanding on why cash is used, all three types of use contexts should be studied. However, as the theoretical and empirical literature focus on the payment instrument choice for transaction purposes at POS, the focus in this thesis will also be on drivers of cash use for POS transactions.

# 3. Theory on drivers of cash use

## 3.1 Theory on the choice between cash and cards for transaction purposes at points of sale

The payment instrument choice is commonly considered to be a two-stage decision. In stage 1, the consumer has to choose whether to adopt of a specific instrument. Stage 2 decision is the one made at the point of sale: the consumer will have to choose which instrument to use of the set of payment instrument at hand. However, as consumers would not adopt any costly payment instruments they do not plan to use, the adoption and intensity of use decisions are to some degree simultaneous. (Von Kalckreuth et. al., 2014a.)

There are two strands of literature in which a consumer's choice of payment instrument at points of sale are modelled. One is a literature modelling the demand for money, more precisely extensions of the Beaumol-Tobin inventory model (see Beaumol, 1952; Tobin, 1956), and the other is a literature on the two-sided payments market.

The Beaumol-Tobin type models on money demand are based on the idea that acquiring cash incurs withdrawal costs while holding cash incurs opportunity costs, so there is a trade-off between these costs, which the consumer has to take into account when making the decision on how much cash to hold for transaction purposes. The majority of these models do not include the choice between cash and its electronic alternatives, which is why they are of no use in studying the choice between alternative payment instruments. Two models that study the choice between cash and cards, one by Whitesell (1989) and another by Alvarez and Lippi (2017), are analysed in this thesis. In the model of Whitesell (1989), the choice between cash and card at POS is determined by the size of the transaction, as the relative costliness of cash and cards vary by the value of a transaction. In Alvarez and Lippi (2017) the consumers will choose between a cash only and a cash and card strategy. The choice of the strategy is driven by the price of a cash withdrawal, together with other prices related to cash and card use.

The two-sided payments market models have been developed to analyse the payment card market, with a focus on trying to answer the question of whether the level and the asymmetric structure of the prices on this market are due to card providers exercising market power or to the nature of the service (Bolt and Chakravorti, 2008). The insightful idea in these models is that network effects have a major role in payment card markets. The actual consumer choice of payment instrument is only a small part of these models and the focus is on the choice of card adoption and usage, whereas cash is merely a default option and not in the centre of attention. In most models (see for example Rochet and Tirole, 2002; Wright 2003), the consumer benefits are assumed to be heterogeneous but the source of this heterogeneity is not modelled. A model by McAndrews and Wang (2012) make an exception by having included factors that cause the utilities for card and cash payments to differ and so in their model the card adoption decision is determined by the income of the consumer, as the cost structure of cash and cards lead to card becoming relatively cheap only once the level of expenditure (determined by income) is reasonably high.

The last model included in this thesis is a model by Von Kalcreuth, Schmidt and Stix (2014b) in which consumers will choose cash if they need to monitor their liquidity. This will depend on their information storing and processing costs and whether they are liquidity constrained.

Transaction size

The insight of Whitesell's (1989) model, presented in a paper called The Demand for Currency versus Debitable Accounts: Note, is that when the structure of transaction costs differ by payment instrument, the total costs of paying with cash or an alternative payment instrument vary with the value of the transaction. In the model, there are two assets: cash and an interest-bearing account. In addition to direct cash withdrawals the account can be drawn on by cards (and cheques). Card and cheque payments impose fixed per-transaction costs, and variable costs (or benefits) that vary

by the size of the transaction. Cash use, on the other hand, imposes costs of acquiring cash and costs of holding cash: every time the consumer makes a withdrawal she has to pay a brokerage fee, whereas the larger the cash holdings the more the consumer forgoes interest earnings. The problem, then, is to decide which transactions to make with cash and which by card, and the amount of cash to hold, while minimising the costs. Because of the fixed transaction costs related to card use, cards will not be used for small transactions, unless the transaction provides for large variable benefits. The costs of cash, on the other hand, grow with the size of payments cash is used for due to the opportunity costs of holding cash, so cash is not used for big transactions. There exists a threshold value below which it is optimal to pay in cash and above which it is optimal to pay with card.

According to Whitesell (1989), the per-transaction fixed costs of cards and cheques reflects costs such as bank fees for drawing a check, the value of time required to make bookkeeping entries in a chequebook, the time needed to fill out a credit card authorization and waiting for account verification by the retailer and/or the extra time spent in a credit or cheque payment queue versus a cash-only queue. The variable cost proportional to the size of the card or cheque transaction reflects costs and benefits such as the cost of cash discounts foregone, reduced risk of theft and the benefit of float if the debiting of the account occurs after the transaction date. The paper was published in 1989 and the costs reflect the costs and benefits that were present at that time, some of which may not exist in today's societies. The crucial assumption in the model is that the alternatives to cash incur fixed per-transaction costs. As Whitesell (1989) notes himself, "without fixed costs or cash discounts, there would be no reason to hold currency". This means that card (and cheque) transactions have to incur (fixed) pecuniary transaction fees, be slower than cash transactions, or there has to be cash discounts to forego in order for people to ever use cash. If one of these costs exists, cash will be used for small value transactions and cards for high value transactions. If none of these costs exist, people would always use cards (or cheques).

One of the shortcomings of the model is that it abstracts from the costs related to holding a card whereas costs related to holding cash are included. The model also abstracts from the card adoption decision.

Cash burns - an inventory model with cash-credit choice

In their paper Cash Burns - an Inventory Model with Cash-Credit Choice (2017), Alvarez and Lippi develop a model that combines a version of the Beaumol-Tobin inventory model with a type of cash holding model. In Beaumol-Tobin models the consumer uses only cash but has to decide on the optimal cash holding and withdrawal behaviour. In cash holding models the consumer pays with cash as long as there is some on hand, and with card once he runs out of cash (more on cash holding models for example in Bouhdaoui and Bounie, 2012). The idea in Alvarez and Lippi (2017) is as follows. Holding cash incurs opportunity costs in the form of interest foregone and risk of theft. Unlike earlier, however, consumers have a number of free withdrawals per unit of time, and only after having spent all their free withdrawal opportunities will they incur withdrawal costs. Paying with card (Alvarez and Lippi talk about credit cards but the model works equally for debit cards), on the other hand, is subject to a flow cost per unit bought. Alvarez and Lippi (2015) suggest this could reflect the time costs of using card for small value transactions.

Whereas in the Whitesell model the consumer would choose which payments to pay with cash and which with card, here the consumer is assumed to pay with cash as long as he has it on hand due to opportunity costs (for a consumer with cash holdings the cost of obtaining cash is sunk and so he only pays the opportunity costs). The consumer problem, then, is to choose whether to follow a cash burning policy, i.e. to pay with cash until cash balances run out and then to pay with a card until the next free cash withdrawal opportunity comes, or to follow an augmented Beaumol-Tobin policy, i.e. to only use cash with always withdrawing cash once the cash holdings run out, regardless of whether one has to pay for it or not. It turns out that there exists a threshold level for the withdrawal cost below which consumers will follow the

augmented Beaumol-Tobin policy and above which they will follow the cash burning policy. As long as card payments incur a transaction fee in the form of time costs and as long as there are free withdrawal opportunities, the consumer will continue withdrawing cash.

The model abstracts from card maintenance costs, but that is not a problem in this model as cash withdrawals are assumed to happen at ATM's, so even if people choose a cash only policy they will still have a card. Thus, it is a cost incurred in both strategies.

Income

In McAndrews and Wang (2012), cash use incurs a pecuniary transaction cost proportional to the total value of expenditures made with cash. Card use, on the other hand, incurs both a fixed cost for maintaining a card and a percentage fee for using the card. The variable cost per dollar spent in cash is assumed to be higher than the variable cost per dollar spent paying with card. In addition to differing prices of payment instruments, also the prices of merchants differ depending on their size and whether they accept cards or not. The consumer has to choose whether he will adopt a card and pay with it at large and more expensive medium sized merchants while using cash at the small merchants, or not adopt a card and pay with cash at all three types of merchants.

Due to fixed maintenance costs, card adopters have less income to spend but, on the other hand, the marginal cost of card payments is lower than that of cash payments meaning that there exists a threshold level of expenditure, i.e. income, after which adopting and using a card becomes cheaper than using only cash. The implication of the model is that consumers with an income below a certain threshold level will only use cash and consumers with an income level over that threshold will adopt a card and pay with cash only in the case he visits a store that doesn't accept cards.

Cash to monitor liquidity

The starting point in the paper Using Cash to Monitor Liquidity: Implications for Payments, Currency Demand, and Withdrawal Behaviour by Von Kalckreuth, Schmidt and Stix (2014b) is the observation made from the standard Beaumol-Tobin framework that using cash induces opportunity costs for cash holdings and "shoe-leather" costs for acquiring cash, while using payment cards instead of cash would free the consumer from both of these costs. According to the authors, there should be no reason to use cash, unless there exists some advantage cash has but cards don't. They suggest that payment cards are more expensive than cash with respect to costs of planning and budgeting, which are necessities for consumers that are liquidity constrained. This is because with cash one only needs to remember the current account balance and look into ones wallet to know how much he has left to spend, whereas with cards one has to remember to subtract each card transaction from the balance on the account and then to memorise the new balance. Thus, cash would be a first choice for liquidity-constrained consumers with high information processing and storing costs.

Unlike the rest of the models presented here, this model uses non-pecuniary costs related to cash and card use to explain the choice of payment instrument. It abstracts from the adoption decision and costs related to maintaining a card but neglecting costs related to maintaining a card would not matter if it is assumed that people withdraw from ATM's, in which case the cost would be incurred anyway, despite the payment instrument chosen for use.

## 3.2 Summary

In the theoretical literature presented above, cash use at POS has been linked to things such as small transaction size, high cash holdings, cards having higher marginal costs than cash, low income, and the need to monitor liquidity. The mechanism leading to these associations is the differing cost structures of cash and cards. Hence, according to the theoretical literature the payment behaviour in terms of payment instruments adopted and intensity of use is driven by the costs of paying. The money demand

theories presented focus on payment choice at the counter while abstracting from the choice and costs related to card adoption. Costs of acquiring and holding cash are, however, included. In addition, issues related to card acceptance are not included in these models. The two-sided payments market model focuses on the consumer adoption (and merchant acceptance) decision, with the latter bringing heterogeneity into card use. The model includes costs related to card adoption, but seems to abstract from costs related to holding and acquiring cash. Von Kalckreuth et. al. (2014b) have a very different approach. They concentrate on non-pecuniary costs related to storing and processing information.

Turning to the empirical literature, based on the theoretical literature, one would expect to see the payment instrument choice to be affected by factors such as transaction size, income, cash on hand, the need to monitor liquidity and pecuniary and non-pecuniary costs related to cash and card use. In particular, cash use can be expected to decrease in income, transaction size and price of holding and acquiring cash, and increase in costs of cards, need to monitor liquidity, and cash holdings.

Next, I will examine the empirical evidence on what seems to drive cash use and compare the findings with the factors suggested by the theoretical literature to see whether the models get supported by empirical evidence and also to check whether there are some other factors affecting payment instrument choice that are not accounted for by the theoretical models.

# 4. Empirical literature on drivers of cash use

The empirical literature on payment instrument choice was first motivated by questions regarding how the emergence of alternative electronic payment instruments would affect the demand for cash. Later, around the millennium, since electronic payment instruments were found to be more cost-efficient than cash and checks, an interest rose in how to steer consumers to substitute cards for cash. First the focus was on cards: what are the demand side drivers of card usage and what is the role of supply side barriers on it. In 2010´s the focus started to shift from cards to cash when it was noticed that, despite the remarkable changes in payment behaviour towards cards and other electronic payment instruments, cash was still intensively used, especially for lower value transactions.

Although cash can be used both for store of value or precautionary purposes and for transaction purposes, and the drivers of cash use for transaction purposes might differ in person-to-person (P2P) and point-of-sale (POS) transactions, to my knowledge, there exist no empirical studies analysing drivers of cash use for either store of value/precautionary purposes or for cash use for person-to-person transactions. Therefore, this literature review will focus on drivers of cash use at points of sale.

I will start by describing the methodology and the research objectives of this empirical literature review. After this, I will present the empirical evidence regarding drivers of cash use, and discuss whether they support the models presented in the theoretical literature. I will conclude by discussing potential problems in comparing and interpreting the results, and the shortcomings of current literature.

## 4.1 Methodology

The literature on payment instrument choice is extensive, with research questions ranging from studying the payment behaviour in general to studying the use of a specific payment instrument or the effect of a particular factor affecting the payment

instrument choice. As the purpose of this empirical literature review is to look at drivers of cash use, only papers analysing reasons for cash use are included. This leaves out studies that focus exclusively on the use of electronic payment instruments. Additionally, although cards such as debit and credit cards differ in many respects and people probably have different reasons to use them, I will abstract from analysing the choice between different types of cards. This is because, from the viewpoint of cash use, the choice is between cash and an electronic alternative (a card), and whether people prefer credit over debit or debit over credit gives no insight into why some prefer cash over both type of cards.

To my knowledge, no previous literature reviews on drivers of cash use have been made. Therefore, to give an overview of what has been studied and what type of ideas have been proposed, I chose the papers for this literature review by searching through EBSCO and Econlit in April 2016 with search words *payment choice*, *payment choice* and *cash*, and *cash usage*. I also included studies analysing cash use that I found from other sources, such Google scholar et cetera. With these inclusion criteria and this search method, not all papers are of equal quality. The quality of the papers is discussed in chapter 4.2.4 *Potential problems in comparing and interpreting the empirical studies*.

All together, 18 studies are included in the literature review. (A table on the included studies can be found in the Appendix.) The studies cover a time line of 17 years, from 1998 to 2015, with the majority of studies using data from between 2008 and 2012. Geographically the coverage includes 8 countries: there are studies from the US, Canada, the Netherlands, Germany, France, Austria, Finland and Australia. The majority of studies are from the Netherlands.

The countries might differ remarkably in available substitutes for cash, in infrastructure, and in culture. Cheques, for example, have traditionally been a common substitute for cash in the US and France but not in rest of the countries studied (Malkamäki and Tanila, 1990). Infrastructure, such as card acceptance, the type of payment terminals in use, or the speed and coverage of Internet would all

affect the attractiveness of card payments and would likely differ by country as well. Cultural factors such as valuation of payment instrument attributes, perceived and real risks related to the use of different instruments, trust in the card and banking system, and purchase behaviour could also all affect the payment choice and differ by country. Therefore, the reasons for cash use probably vary by country. Additionally, as these factors most likely change with time, the reasons for using cash could change in time within a country. Thus, to get a comprehensive understanding of the drivers of cash use at POS, it might be desirable to look at the differences country wise, and at changes over time. However, in addition to time and place, the studies also differ in research question, and variables and measures used et cetera. All these differences between studies complicate the comparison of the results, as a difference between two countries might just be due to, for example, a difference in research set-up, variables controlled for et cetera. These same problems also complicate analysis of changes within a country.

Due to the numerous aspects that could affect the results, it is impossible to give a comprehensive account on what affects the payment choice, and all the little details that might bias or in other ways affect the results. Therefore, my objective and contribution is to give an overview on the main findings on what seems to drive cash use, and discuss the potential problems in interpreting and comparing the results, and in the strategies commonly used to study the payment instrument choice. I will do this by comparing the effect of a specific regressor, such as income or transaction value, between different studies, even though this is problematic, since, as mentioned earlier, with the studies including different controls, addressing different research questions, and using different measures, the coefficients on a specific regressor are not directly comparable between different studies. However, I will discuss certain issues related to controls used in different studies if I believe, or if it has been suggested, that they might affect the results. I will also distinguish between results from different countries, and, occasionally, between different time points if there seem to be differences. Additionally, potential problems in interpreting and comparing the results, and in research strategies used are discussed in a more general level in chapter 2.4 *Potential problems in comparing and interpreting the empirical studies*.

One interesting question would be to know which factors have the strongest effect on cash use and which factors play only a small part in explaining cash use. Again, as the review includes many studies, all with multiple but different regressors measured on different scales and defined in different ways, the comparison becomes extremely difficult. Therefore, I will only look at the significance and the direction of the effect when discussing which factors seem to affect cash use and which do not.

I will start by introducing the main results. As the payment instrument choice is a two-stage decision, I will first examine factors associated with the intensity of use decision and after that I will turn to factors associated with the adoption decision. Then, I will discuss the theoretical models in light of the empirical findings and the potential problems in comparing and interpreting the results. I will conclude by discussing the limitations of the current research and what other factors might affect payment instrument choice.

## 4.2 Drivers of cash use at point of sale

As the payment instrument choice is a two-stage decision, I will first examine factors associated with the intensity of use decision and after that I will turn to factors associated with the adoption decision. Factors affecting the intensity of use decision are divided into supply side and demand side factors.

### 4.2.1 Supply side factors

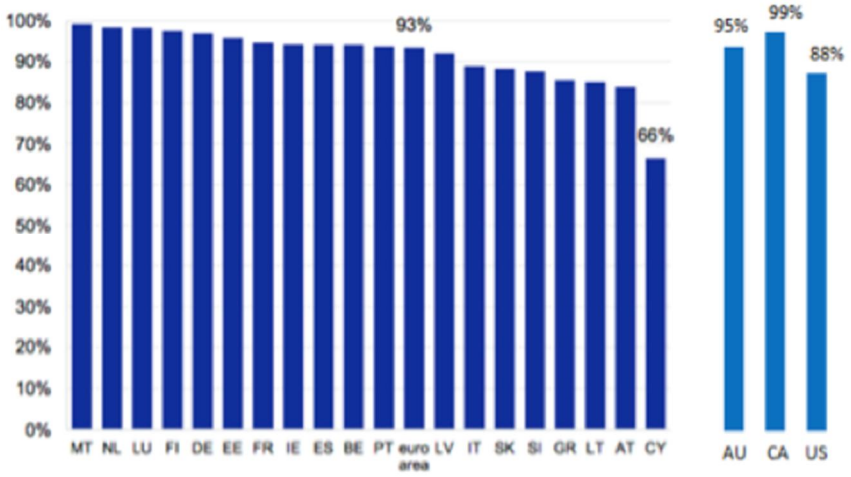
One reason for people to use cash could be that card payments are not available, either because people do not have access to cards or because merchants do not offer the option to pay with a card. Although within the two-sided payments market framework platforms comprise the supply side, and consumers and merchants comprise the demand side, I have categorized both access to cards and merchant acceptance of card payments as supply side factors for payment instrument choice, as,

from the point of view of a consumer, they both affect the availability of card payments at POS but do not reflect the consumers demand for payments.[3]

*Supply of cards*

If people do not have access to debit or credit cards they have usually no other option but to use cash.[4] According to the available data from the euro area, Canada, the US and Australia (Chart 1), card adoption rates have been quite high in the 2010's for most countries, but they seem to remain below 100%, indicating that in most countries there still exist people who do not own a card (Esselink & Hernández, 2017, Bagnall et. al., 2016). Unfortunately there are no studies examining the reasons for remaining cardless. Although lower levels of card adoption rates have been associated with, for example, young and old age, and low level of education (Esselink & Hernández, 2017, Van der Cruijsen and Plooij, 2015), it is impossible to know whether these groups of consumers have lower levels of card ownership due to supply side factors or due to demand side factors. It could very well be that the young and old, and those with lower levels of education simply prefer not to have a card. Thus, the existing literature does not tell whether there exist some restrictions on the availability of cards, so that some people use cash due to lack of alternatives.

Chart 1. Card adoption rates by country




Source: Esselink and Hernández, 2017; Bagnall et. al., 2016. Data for Canada is from 2009, for Australia from 2010, for the US from 2012, for Germany from 2014 and for the rest from 2016.

[3] This same categorization has been used in some of the empirical literature, see for example Wakamori and Welte (2017).

[4] In some countries other options such as cheques, prepaid cards, credit transfers and direct debits might be available. However, their share on the number of POS payments is low, for example in euro area in 2016 it was 2,1% of all POS payments (Esselink & Hernández, 2017).

*Acceptance of cards*

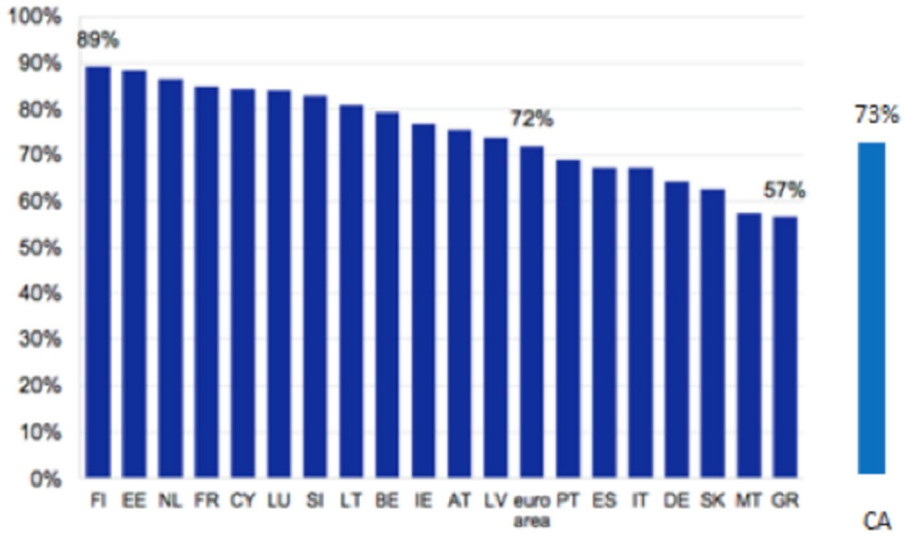
In addition to restrictions on card adoption, the possibility to use cards depends on whether card payments are accepted by merchants or not. If cards are not accepted, people will have to use cash instead. According to the available data (Chart 2), card acceptance seems to range between 57 and 89 percent within the euro area and Canada (no data on the US or Australia was available) (Esselink & Hernández, 2017, Bagnall et. al., 2016). Not surprisingly, when using payment diary data where people record for each transaction whether cards were accepted or not by the merchant, acceptance of cards decreases the probability to use cash (Arango et. al., 2015, Bagnall et. al., 2016). In Canada, for example, it was estimated that cash use would have been 27% lower in 2009 if cards had been universally accepted (Arango et. al., 2015).

It seems that card acceptance can vary by transaction size. For example in Canada in 2009 the card acceptance rate in the highest transaction value quartile was 36 percentage point higher than it was in the lowest transaction value quartile, while the difference was 27 percentage points in Austria and 59 percentage points in Germany in 2011 (Bagnall et. al., 2016). Although card acceptance rates might be lower for lower value transactions[5], this does not necessarily mean that people use cash for low value transactions because cards are not accepted. Bagnall et. al. (2016) perform a scenario analysis and find that whereas Canadians would increase their card use in both the lowest and highest transaction value quartiles if cards were better accepted, in Austria and Germany people would only increase card payments in the highest transaction value quartile but would keep paying the smallest transactions in cash. On the other hand, Wakamori and Welte (2017) studied whether the cash preference for small value transactions in Canada is driven by supply side (acceptance) or demand side (consumer preferences) factors, that is consumer preferences, and they found that the demand side is the main driver explaining cash preference for small value transactions. Thus, it seems that although some Canadians would prefer to pay low value transactions with card, many prefer using cash.

[5] Lower acceptance rates for lower value transactions might reflect different phenomenon. It is possible that merchants accept card payments only for payments that exceed a certain threshold value or it could be that stores that sell low value products, for example kiosks or cafes, do not accept cards at all.

In summary, low merchant card acceptance seems to explain some of the cash use. Although acceptance rates, at least in some countries, are lower for low value transactions, it seems that acceptance is a restriction for card use in higher value purchases rather than lower value purchases, as it seems that people would use cash for small value purchases anyway, regardless of the level of card acceptance.

Chart 2. Perceived card acceptance by country




Source: Esselink and Hernández, 2017; Bagnall et. al., 2016. Data for Canada is from 2009, for Germany from 2014 and for the rest from 2016.

#### 4.2.2 Demand side factors

In the empirical literature, demand side factors affecting the payment instrument choice are usually divided into four categories: demographic factors, perceptions on payment instrument attributes, transaction specific factors and habit. Many of the studies do not offer any specific explanation on what the regressors are supposed to stand for - other than consumer heterogeneity in costs or preferences - and how they are supposed to affect the payment instrument choice.

It seems, however, that there is heterogeneity in how much importance people place on different attributes, such as costs, speed, ease of use, security, need to monitor expenditures and anonymity, and into which payment instrument people attach the attribute to. Transaction specific characteristics, such as the size of a transaction, the type of a store the purchase is made at, and the amount cash people have in their

wallet, seem to have a strong effect on the payment instrument choice as well, possibly due to cost factors presented in the theoretical literature. Demographic factors, on the other hand, are suggested to account for some unobserved heterogeneity that is not accounted for by the attributes commonly used in the studies, whereas some of the behaviour is considered to be determined purely by habit.

An alternative explanation, offered by the psychological literature, is that transaction specific characteristics affect the payment choice by functioning as context cues that trigger habits, while perceptions on attributes might either reflect real preferences people act upon, or they could reflect post hoc explanations for behaviour that actually is driven by habit. Also in this context, demographic factors most likely reflect some unaccounted heterogeneity in preferences.

## Payment instrument attributes

Consumer perceptions on payment instrument attributes are usually intended to capture consumer heterogeneity in preferences (Arango et. al., 2015) or heterogeneity in underlying non-pecuniary costs and benefits, such as the level of difficulty in remembering pin numbers or doing online banking to keep track of expenses, or the (perceived) level of risk in holding and withdrawing cash or being exposed to identity theft (Arango et. al., 2011). Most commonly used attributes are perceptions on ease of use, speed, security, anonymity, expense monitoring, and acceptance.

### *Costs*

Logically people would be expected to react to costs by choosing the payment instrument that is cheaper. As has been discussed earlier, cash and cards incur different type of costs, and the costs vary by country. Fixed costs for adopting and maintaining a card are very common across countries. The existence of transaction fees is country specific. For example in the UK, Australia, the Netherlands, and in part of the US, debit card surcharges have been allowed, whereas in Canada and in some

other parts of the US they have been forbidden (MSE, 2017; RBA, 2012; CBC, 2012; McAndrews and Wang, 2012; Bolt et. al., 2010).[6] Since 2018, surcharges on card payments have been forbidden in all of the Europe (Directive 2015/2366 on payment services). In addition to transaction fees, there can also be other type of restrictions. For example in Canada, although merchants have not been allowed to surcharge card payments, some debit card plans come with a limited amount of free transactions (Arango et. al. 2011). According to McAndrews and Wang (2012), at least in the US, stores might provide cash discounts if consumers pay with cash. In this case, card payments incur costs in the form of cash discounts foregone.

Turning to cash, pecuniary withdrawal costs are relatively common, at least in the euro area, where, on average, 40% indicated that they at least sometimes pay a fee for withdrawing cash at ATM's in 2016 (Esselink, Hernández, 2017). I could find no information on fees for withdrawing cash at a bank counter, but at least in Finland it is free of charge (at one's own bank). In addition to pecuniary costs, cash incurs opportunity costs in form of interest foregone and risk of theft. There is no data available on interest rates on checking accounts, but since the financial crisis in 2008, central bank interest rates have decreased remarkably, pulling down all other interest rates including interest rates on checking accounts (European Central Bank (b), Bank of England, Trading Economics). Thus, in the 2010's the opportunity cost of cash has been relatively low, although it varies by country. Also the risk of theft varies by country. The effect of risk of theft on payment instrument choice is discussed later, in the chapter Security.

According to the empirical studies, people seem to react to visible costs but not necessarily on their own cost perceptions. Bolt et. al. (2010) study the effect of debit card surcharges on consumer payment choice in 2006 in the Netherlands, where retailers used to be allowed to apply a surcharge to customers who use their debit cards for payments below a certain threshold value. Comparing the debit card shares

[6] Credit card surcharges are more common (see for example McAndrews and Wang, 2012) but as one can always use debit card instead, the surcharge of credit cards can be avoided. Therefore, the focus here is on debit card surcharges.

between retailers that applied a surcharge and retailers that did not apply a surcharge, they found that applying a debit card surcharge decreased the share of debit card payments in total payments by 8 percentage points. Von Kalckreuth et. al. (2014a and 2014b) find that in Germany in 2008 people facing a line fee for each transaction on the account statement were more likely to use cash, while people in Canada in 2009 with a debit card plan including a limited amount of free transactions were more likely to use cash (Arango et. al., 2011 & 2015). Turning to the cost perception studies, in Bagnall et. al. (2016) perceiving cash as cheap relative to other payment instruments did not affect the probability of using cash in any of the countries studied, that is, in Austria (in 2011), Canada (in 2009) and the United States (in 2012). Van der Cruijsen and Plooij (2015) report similar findings for the Netherlands both for year 2004 and 2014. On the other hand, in a study by Stavins (2013), perceiving cash as relatively cheap was associated with higher cash use amongst American consumers in 1998, while in Canada, using the same Canadian data as was used by Bagnall et. al. (2016), Arango et. al. (2011) and Arango et. al. (2015) find that those consumers who stated avoiding fees as a top reason for choosing their main payment method used more cash. Therefore, it seems that people tend to avoid costs when they are faced with them but general cost perceptions are less motivating to act upon.

*Ease of use*

It is presumable that people who consider ease of use to be important when choosing what payment instrument to use are more likely to use the instrument they perceive as the easiest. This gets support from the empirical studies. People tend to use the instrument they find easiest to use, be it cash, debit, or credit card. This finding is very general across countries. (Arango et. al. 2011, Stavins 2013, Arango et. al. 2015, Van der Cruijsen and Plooij 2015, Bagnall et. al. 2016.) However, the instrument to which ease of use is most commonly attached to seems to vary by country. On average, cash is perceived as easier to use than any cards in Austria and Germany, whereas debit card is perceived as easier to use than cash in France, and the Netherlands. In the US, both debit and credit cards are perceived as easier to use than cash. (Bagnall et. al., 2016.) For Canada the results are mixed, as cash is perceived easier than cards in

Bagnall et. al. (2016) but debit card is perceived easier than cash in Arango et. al. (2011).[7] Despite these differences in average perceptions it seems that in all countries studied, for some people, perceiving cash as easy to use (or possibly, finding cards inconvenient, unfamiliar or tricky to use) is a determining factor for choosing cash instead of cards.

*Speed*

It is presumable that, as in the case of ease of use, people who consider speed to be important when choosing what payment instrument to use are more likely to use the instrument they perceive as faster. Speed, however, is more objective in nature than ease of use, as transaction time can be unambiguously measured. Still, transaction times for cash and card payments might vary significantly between people: some are quick to put the card in the payment terminal and insert the PIN while others might have difficulty in knowing where to place the card and in remembering the PIN. On the other hand, some handle notes and coins smoothly while others might be clumsy.

Although people differ in which instrument they use faster it seems that in general speed is something considered to describe cash transactions. Some of the theories introduced in the previous chapter, for example, build on the idea that cash transactions are faster than card transactions in general. The empirical evidence, however, is not uniform. Although cash payments indeed seem to be faster than (PIN or signature) card payments for example in Canada, Australia and many European countries, in Denmark the transaction times are almost identical for cash and cards (see Table 1).

[7] This is surprising as the two studies use the same dataset. I could not find any explanation for this.

Table 1. Speed of cash and card transaction in seconds.

| | Country | Year | Cash transactions | Contacless card transactions | (Debit) PIN transactions |
|---|---|---|---|---|---|
| The Cost of Point-of-Sale Payments in Canada, Kosse et. al. 2017 | Canada | 2014 | **11,61** | **15** | **26** |
| The Evolution of Payment Costs in Australia, Stewart et. al. 2014 | Australia | 2014 | **25,00** | **20** | **35** |
| Social costs of POS payments in the Netherlands 2002-2012: Efficiency gains from increased debit card usage, Jonker 2013 | The Netherlands | 2002<br>2011 | **19**<br>**15** | | **26**<br>**19** |
| Costs of payments in Denmark, Danmarks Nationalbank 2011 | Denmark | 2011 | **14,3** | | **14,9** |
| The Social and private costs of retail payment instruemnts - a European perspective, Schmiedel et. al. 2012 | Average of 13 european countries | | **22** | | **29** |

The effect of speed on the payment instrument choice has only been studied in three countries: Canada, the Netherlands and Germany. In Canada in 2009, people who valued speed highly tended to use more cash than those who did not value speed highly. (Arango et. al. 2011, Arango et. al. 2015). Thus, it seems that Canadians attach speed to cash. In the Netherlands, on the other hand, when respondents were asked to rate cash and debit cards in terms of speed, it was more commonly attached to debit card payments than to cash payments, both in 2004 and in 2014. This is a little surprising considering that, according to Jonker (2013) (Table 1), on average, cash transactions have been faster than card transactions during the period between 2002 and 2011. Of course, if Dutch people tend to use the instrument they find faster - which indeed seems to be the case (Van der Cruijsen and Plooij 2015) - transaction time studies will measure people while they use the instrument they pay faster with. Thus, although card transactions are on average slower than cash transactions it might be that for those who rated cards as faster, paying with cash would take even longer. In any case, whereas people in Canada seem to attach speed to cash, in the Netherlands, the majority seemed to attach speed to cards.

In Germany in 2008, no statistically significant relationship between speed and payment choice was found (Von Kalcreuth et. al., 2014 a). However, in this study speed referred to respondents indicating that speed is an indispensable attribute of a payment instrument, without specifications on which payment instrument they attached it to. As it is possible that people differ in which payment instrument they attach speed to, as is the case in Netherlands, analysing the effect of general speed

valuation on behaviour might be problematic, as the speed incentive can lead to two opposing payment instrument choices.

Although cash is commonly considered as faster than cards, the transactions times vary by country, and in some countries the difference might be negligible. Additionally, the individual subjective speed perceptions on cash and cards can be heterogeneous within a country and might not reflect the measured transaction times, indicating that using general speed valuations (unattached to any specific instrument) can lead to misleading results. Evidence from Canada and the Netherlands supports the idea that people use cash because it is faster. However, for some individuals, paying with card is faster, and in some countries, there seems to be no difference in transaction times for cash and card payments.

*Security*

The logic behind the effect of security on payment instrument choice is that if people worry about safety issues they should be preferring payment instruments they perceive as safe and avoiding payment instruments they perceive as risky. Most studies suggest this is indeed the case. Perceiving cash safe, or debit cards unsafe has been associated with higher cash use in several countries (Stavins 2013, Kosse 2013, Arango et. al., 2015, Van der Cruijsen and Plooij 2015, Bagnall et. al. 2016), while fearing theft is negatively correlated with cash use (von Kalckreuth et. al. 2014b, Kosse 2013, Van der Horst and Matthijsen 2013). However, also contradicting results exist. In Canada, where fear of fraud has been associated with higher cash use (Arango et. al., 2015), perceiving cash safe relative to other payment instruments was counter-intuitively associated with lower level of cash use (Bagnall et. al., 2016), and perceiving security in terms of fraud, theft or counterfeiting as an important factor was negatively correlated with cash use and positively correlated with debit card use (Arango et. al., 2011). All these studies used the same data set.

There could be a couple of explanations for counterintuitive findings. First, since a survey question for studying the effect of security can be phrased in many different

ways, i.e. people can be asked about safety perceptions or risk perceptions, and since potential examples or words used to describe risks can lead people to think of either card related risks or cash related risks, it is possible that respondents and researchers don't always have the same thing in mind. Without the survey questionnaire it is impossible to check for the exact wording, which might give some clue on what respondents had in their mind. Also, when risks associated with both cash and cards are collected under the same variable - as seems to be the case in the study by Arango et. al. (2011) where the control is "perceiving security in terms of fraud, theft or counterfeiting as an important factor" - it is not clear how this type of control should affect the payment instrument choice.

Second, although it seems most logical for security concerns to steer the behaviour, it is also possible that other factors determine the payment instrument choice, and once certain payment instrument has been chosen people are more concerned with the safety issues of this specific payment instrument rather than with the safety concerns of the instruments they don't use. This could explain the findings of van Kalckreuth at. al. (2014 a), where fear of theft was positively correlated with the probability of paying exclusively with cash at daily retail in Germany in 2008, that is, those who used only cash for daily retail purchases usually were more afraid of robbery.

Hence, although most evidence points towards security concerns steering payment choice, also contradicting findings exist, but it is impossible to determine with the existing evidence whether the contradicting findings reflect real behaviour - for example, people merely being concerned with the security concerns of the specific instrument they use - or something else such as poorly defined controls, ambiguous survey questions, or just the effect of chance.

*Expense monitoring*

It is often considered that cash and cards vary in their usefulness as devices to track and control expenditure. Simply put, as all expenditures paid by card leave a trace on the bank statement, cards are considered to be better for tracking the nature of

expenses. Cash, on the other hand, is generally considered to be better for setting pre-defined budgets and for monitoring the amount left to spend. (Hernandez et. al. 2017.) Therefore, people who have a need to track the nature of expenses are expected to prefer cards, while people who have a need to control spending are expected to prefer cash. This idea does get some support from the empirical studies (for example Arango et. al. 2011, Arango et. al. 2015, and Von Kalckreuth et. al. 2014b). However, people are not homogeneous in what instrument they consider as the best one to address a specific need with. Contradictory to the theory, some people seem to consider cash as the best tool for record keeping/tracking the nature of expenditures and use it for this purpose (Stavins, 2013, Hernandez et. al., 2017, Arango et. al., 2015), while others seem to consider debit card as the best tool for budget control and use it for that purpose (Hernandez et. al., 2017).

Two separate features of cash can be identified that make it a good tool for exercising budget control. First, cash reduces information storing and processing costs relative to cards, as one can easily stay on track of the amount left to spend just by glancing into his/her pocket and memorising the account balance after the latest withdrawal (Von Kalckreuth et. al. 2014b). If a strategy of setting pre-defined budgets is deployed - say, for example, a target of using only 100 € for food per week - cash becomes even more efficient relative to cards as not even the account balance needs to be memorised. All that is needed then, is to withdraw the desired amount, in this example 100€, in the beginning of the week, after which a mere glance into the pocket is enough to tell how much there is still left to spend during the remaining days of the week. Hence, cash is more efficient than cards for setting pre-defined budgets and/or for monitoring the amount left to spend.

Although many studies analyse the effect of the different needs on the payment instrument choice, few study what type of people have these needs, that is, what type of people have the need to set pre-defined budgets and/or control the amount left to spend. Two exceptions are the studies by Von Kalckreuth et. al. (2014b) and Hernandez et. al. (2017). Von Kalckreuth et. al. (2014b) hypotethise that it is liquidity constrained people with high information processing and storing costs that have the

need to monitor their remaining liquidity, and they will do this by using (mainly) cash and making very few withdrawals to make it easier to keep track of how much there is left to spend. This is indeed what they find: liquidity constrained people with high information processing costs were more likely to have higher cash shares, to pay larger amounts in cash and to make fewer but higher withdrawals.

Hernandez et. al. (2017), on the other hand, hypotethise that it is financially constrained people with low self-control that have the highest needs, not only for budget control, but also for tracking the nature of expenses and the total amount spent. They find that financially constrained people are indeed more likely to place value on all these needs, but contradictory to their expectations, it is people with good self-control rather than people with bad self-control that seem to consider these needs important. The authors cannot explain this and conclude that their hypothesis was not right on this regard. I do not think this finding directly refutes their theory on self-control. It is possible that people who deploy some strategy to exercise budget control - say for example the strategy to set pre-defined budgets and to use cash to help sticking to this budget - might originally have had self-control problems (which is why they deployed the strategy in the first place), but once the strategy is in use they get better at sticking to their budgets, and would eventually perceive themselves as having good self-control. Alternatively, it is indeed only people with good self control that are able to stick to strategies aimed at addressing one of the needs related to either tracking the nature of or controlling for expenditures. Either way, Hernandez et. al. (2017) find that people are heterogeneous in their valuation of needs, and in what payment instrument they consider as the best one for addressing these different needs. People who consider cash better than cards for addressing a specific need are more likely to use cash and people who consider cards better than cash for addressing a specific need are more likely to use cards.

Another feature of cash that makes it particularly helpful in controlling overspending is that, according to empirical findings in psychological research, cash use seems to have a restrictive effect on spending behaviour. There are several theories on what could lie behind this effect. It has been attributed, for example, to a 'decoupling-effect',

referring to the idea that cash payments are more transparent than electronic payments and thus induce more pain, leading the consumer to use more consideration before spending. Another theory is that people use their past spending as a reference point to guide their future spending. Past spending reduces purchase intention when it is transparent (i.e. payments made with cash or checks) since it is easier to remember. A third theory is that, in contrast to electronic payment instruments, the tangibility of notes and coins creates a more conscious (or unconscious) awareness that something of value is being exchanged. Using sight and touch intensifies the consumer's ability to process the transactional information and creates an immediate physical and visceral experience of the amount spent. Thus, a cash-using consumer is more aware of his spending. (Khan, Belk and Craig-Lees, 2015.) Whatever the mode of action, if cash use increases the awareness (or card use decreases the awareness) of how one spends money, cash will be a better tool than cards in controlling overspending. Unfortunately, to my knowledge, this question has to not been studied within the payment instrument choice literature.

However, a study by Cohen, Rysman and Wozniak (2018) addresses the question of whether transaction size determines the choice of payment instrument or whether the choice of payment instrument determines the transaction size with a scanner data from the US between 2006 and 2008. They find that, all other things equal, adopting a card increased the average transaction value by 16%, indicating that the transaction size might be determined by the payment instrument choice, that is cash use indeed might have a restrictive effect on the purchase behaviour while card use does not. Their explanation for this phenomenon is that when using a card people are not restricted by the amount of cash they have with them. According to this explanation, people are not necessarily trying to restrict their behaviour, rather, it is externally restricted by the repertoire of payment instruments they have adopted.

In summary, cash can be used either to monitor how much is left to spend or to help control the spending behaviour. Financially restricted people with high information processing and storing costs are likely to benefit from the cost lowering feature of cash whereas financially restricted people with self-control problems are likely to benefit

from the behaviour restricting feature of cash. Alternatively, it is financially restricted people with good self-control that are able to exploit the behaviour restricting feature of cash. However, although cash would theoretically seem better for budget control and/or controlling the amount left to spend, some people seem to consider cards better for these purposes and use cards instead, while others, quite counter intuitively as well, consider cash better than cards for tracking the nature of expenses and use cash for this purpose instead. Additionally, it is worth noting that also this attribute might be vulnerable to the wording used in the questionnaire: for example Hernandez et. al. (2017) use notions such as 'budget control' and 'knowing the amount left to spend' interchangeably, but they might not be that, as it could be argued that the notion of 'budget control' is more likely to make people uniformly to think about a situation where there is a wish to restrict the spending behaviour, whereas the notion 'knowing the amount left to spend' might trigger different ideas depending on whether the respondent uses cash to monitor liquidity or card to monitor total amount spent.

*Anonymity*

Anonymity is something attached specifically to cash - when paying with cash there exists no records on what the money has been used on. It is often thought that anonymity is one of the reasons why cash is so intensively used in Germany (The Economist, 2016). The evidence is mixed. In Von Kalckreuth, et. al. (2014a) those who indicated that anonymity was an indispensable attribute of a payment instrument were more likely to use cash, while in Von Kalckreuth, et. al. (2014b) those, who agreed with anonymity being important and cash being the only instrument fulfilling it, were not more likely to use cash. In Canada, importance of anonymity of cash relative to cards had no effect on the probability of cash use in Arango et. al. (2015), whereas in Arango et. al. (2011) the importance of anonymity was linked with higher credit card use. This finding is quite surprising and the authors suggested this might be due to consumers who use credit card being more aware of the possibility of identity theft. All in all, although anonymity is generally considered to explain some of the cash use, it did not get very much support in these studies.

Transaction specific characteristics

*Transaction size*

Theory suggests (for example, Whitesell 1989, and Avarez and Lippi 2016) that cash is more efficient for small value transactions than cards, either because card transactions are slower or more expensive than cash transactions. Hence, people are expected to pay small payments with cash and big payments with cards. This idea is strongly supported by the empirical studies: the result of cash use being negatively correlated with transaction size is very robust, holding over time and countries. (Klee, 2008, Arango et. al., 2011, Jonker et. al. 2012, Wakamori and Welte, 2017, Cohen and Rysman, 2013, Kosse and Jansen, 2013, van der Horst and Matthijsen, 2013, von Kalcreuth et. al., 2014a, von Kalcreuth et. al., 2014b, Arango et. al., 2015, and Bagnall et. al. 2016.) The reason for this, however, might not be that clear.

Although differences in transaction costs for cash and cards seem to indeed exist in several countries, for example, with some merchants in the Netherlands placing surcharges on small value card payments (Bolt et. al. 2009), with some merchants providing cash discounts in the United States (McAndrews and Wang 2008) and with some people having limited amount of free debit card transactions in Canada (Arango et. al., 2011, Arango et. al., 2015), and even though these costs seem to affect the payment choice, the effect of transaction size still remains significant after controlling for costs.

Transaction time, on the other hand has not been controlled for in any of the payment instrument choice studies. As some cost studies show (see for example Kosse et. al. 2017, Jonker, 2013, and Schmiedel et. al. 2012), there exist differences in cash and card transaction times. Hence, it is possible, that one reason explaining why people prefer to use cash for small value transactions is that cash payments are faster.

Also supply side factors could affect the payment choice. It has been suggested that paying small transactions with cash could partly be due to issues relating to merchant acceptance: the level of merchant acceptance might be smaller at the type of POS where smaller value purchases are made (for example Kosse and Jansen, 2013). However, Wakamori and Welte (2017), using the 2009 data from Canada, addressed specifically this question and found that making small value transactions was mainly driven by consumer preferences, rather than merchant acceptance. Additionally, most studies analysing transaction size also control for merchant acceptance. Thus, it seems that people would make small transactions in cash anyway, even if cards were accepted.

It is also possible that there is a simultaneous causality running from transaction size to payment instrument choice and from payment instrument choice to transaction size. Cohen, Rysman and Wozniak (2018) study the potential endogeneity of transaction size. They find that the average transaction size seems to increase once people adopt a card. More precisely, they find that although transaction size indeed seems to affect the payment instrument choice, the effect is overestimated if the simultaneous causality is not corrected for.

Hence, it seems that, according to the empirical literature, although pecuniary transaction costs and merchant acceptance account for some of the negative correlation between transaction size and card use, most of it is explained by something else. A very potential explanation, at least in some countries, is that cash transactions are faster than card transactions, which is why cash is preferred for small value transactions. Another potential explanation is that when people use cards they tend to spend more. This could be either because cash use has a restrictive effect on spending behaviour, as is suggested by the psychological literature, or because when using card, one is not constrained by the amount cash one has in the wallet, as is suggested by Cohen, Rysman and Wozniak (2018).

*Type of POS*

Theoretically, it is unclear why the type of point of sale (POS) should affect the payment instruments choice. It has, however, repeatedly been shown that the type of POS seems to affect the payment instrument choice: people are more likely to use cash at places such as bars, restaurants, cafes and kiosks, that is, at places where transaction values are relatively low, whereas cards are more commonly used at gas stations, and fashion, shoe and department stores, that is, at places where transaction values are high. The finding is robust over countries. (Arango et. al., 2011, Arango et. al., 2015, Jonker et. al., 2012, Kosse and Jansen, 2013, Bagnall et. al., 2016.) However, as all of these studies control for transaction size, it cannot explain the phenomenon. Another potential explanation, suggested by Kosse and Jansen (2013), could be merchant card acceptance. The type of POS, the (average) size of transactions, and merchant card acceptance are highly correlated, that is, certain kind of stores, such as kiosks, sell the type of products that are relatively cheap, leading to smaller value purchases on average, and these type of stores tend to have lower level of card acceptance (possibly due to it being relatively expensive to accept card payments for small value transactions). Therefore, the commonly seen "type of POS" -effect might reflect the different levels of card acceptance in different type of stores. However, all but one study use both transaction value and acceptance of cards as controls, and the type of POS still remains a significant regressor. Thus, the reason behind heterogeneous preferences on what payment instrument to use at which type of POS remains unknown.

*Cash holdings*

Several papers have included a control for the respondents average cash holdings or cash holdings in the beginning of the diary and they all find that cash holdings are positively correlated with cash use (Kosse& Jansen, 2013, Van der Cruijsen et. al., 2017, Bagnall et. al., 2016, Arango et. al., 2011, and Arango et. al., 2015). The idea for including these type of variables as regressors lies in that the marginal cost of using cash depends on whether the consumer has it in his wallet or not: having it in the

wallet makes the marginal cost of using cash close to zero, whereas not having it in the wallet would lead to costs of acquiring cash (Arango et. al., 2015). Thus, people with (enough) cash in their wallets would presumably be more likely to use cash than those with very little or no cash in their wallets.

However, it is commonly admitted that the causality could run in the other direction as well: that people first choose to what degree they want to pay with cash and to what degree with cards, and then withdraw cash accordingly.[8] Thus, although cash at hand might be a good predictor of payment behaviour, and although it might be an interesting study subject as such if the purpose is to analyse cash holdings and withdrawal behaviour, in the payment instrument choice framework it is a bad control (see Angrist and Pische, 2008), that is, it is an outcome variable itself, reflecting the same thing as the dependent variable: the level of cash use. The problem with including bad controls is that the regression will not have a causal interpretation (Angrist and Pische, 2008).

Demographic factors

Demographic factors are in general considered to control for heterogeneity in adoption costs and consumption behaviour, and to proxy relative costs (Hyytinen and Takalo, 2009 and von Kalcreuth, Schmidt and Stix, 2014a). However, it is not always theoretically clear in what way they should affect the payment instrument choice.

*Education*

Education is amongst the least controversial regressors explaining cash use: practically all studies indicate that people with lower levels of education are more likely to use cash than those with higher levels of education (Jonker, 2007, Klee, 2008, Hyytinen & Takalo, 2009, Arango et. al., 2011, Cohen & rysman, 2013, Kosse, 2013, Hernandez et. al., 2017, von Kalckreuth et. al., 2014b, Arango et. al., 2015, van der Cruijsen & Plooij,

[8] Also in the model by Alvarez and Lippi (2017), although cash was always used if at hand, the actual reason for withdrawing and using cash was that card payments were time wise more expensive than cash payments.

2015, Bagnall et. al., 2016.) It has been suggested that this would be due to highly educated people being more likely to follow trends and to use new payment instruments (for example, Van der Cruijsen et al. 2017).

*Income*

Income could reflect both financial incentives, such as relative costs of adopting and using a card or the opportunity costs of acquiring cash, and demographic factors, such as heterogeneity in consumption behaviour (Hyytinen and Takalo, 2009 and von Kalcreuth, Schmidt and Stix, 2014a).

In most studies cash use seems to decrease with income (Jonker, 2007, Klee, 2008, Hyytinen & Takalo, 2009, 2011, Cohen & Rysman, 2013, Kosse, 2013, Hernandez et. al., 2017, von Kalckreuth et. al., 2014a, von Kalckreuth et. al., 2014b, 2015, van der Cruijsen & Plooij, 2015.). It has been proposed that this could be due to lower income people making smaller payments, which leads to higher cash use, as people tend to pay small transactions with cash (for example, Arango et. al. (2015). However, most studies control for transaction value and the relationship still persists, so this cannot explain the phenomenon. Arango et. al. (2015) suggest that another explanation might be that people with higher income have better access to credit cards and additionally they have more often credit cards with rewards, so they have stronger incentives to pay their (usually more expensive) purchases by card. They use a 2009 data from Canada and find that, when controlling for rewards (and transaction value), income indeed has no effect on the payment instrument choice. No other studies have included credit card rewards as a control. However, in the cross-country comparison by Bagnall et. al. (2016) income had no effect in Canada (nor in Austria, Germany, or the Netherlands either) even though rewards were not controlled for. Hence, it remains unclear why income sometimes is negatively correlated with cash use and sometimes not.

Despite the relatively strong negative correlation between income and cash use, when studying whether a change in income level had any effect on payment choice in the US

in 2006-2008, Cohen and Rysman (2013) found that, although an increase in income increased the probability to use cards, it had no effect on cash use (people switched from using cheques).

*Age*

Old people are commonly considered to use more cash than young people. Two explanations have been suggested: a cohort effect and an age effect. The cohort effect refers to the idea that habit is a big driver of payment behaviour and since habits are formed in the youth, older consumers are less likely to use payment instruments that have become more common in the last decades. Age effect refers to the idea that age itself affects the choice of payment instrument, that is, attitudes to risk or tastes might be different in different times of the life course (Mann, 2011). When looking at descriptive statistics, the idea of old people using more cash gets strong support but regression results are surprisingly mixed.

The probability to use cash has been found to increase with age in Austria (Bagnall et. al., 2016), in the Netherlands (Jonker, 2007, van der Cruijsen and Plooij, 2015, Bagnall et. al., 2016) and in the US (Cohen and Rysman, 2013), although in the cross-country comparison by Bagnall et. al. (2016) cash use in the US had a U shape with the middle aged people using cash the most. A similar U shaped pattern appears also in France. For the Netherlands, the results are mixed, as, in contradiction to Jonker (2013), Van der Cruijsen and Plooij (2015) and Bagnall et. al. (2916), Hernandez et. al. (2017) find no effect for age on cash use, and in the neuroscientific study by van der Horst and Matthijsen (2013) no general generation effect was found either. On the other hand, in Canada (Aranago et. al., 2011, Arango et. al., 2015, Bagnall et. al., 2016), and in Australia (Bagnall et. al., 2016) age does not seem to have any effect on the probability to use cash. The results for Germany are mixed as in Von Kalckreuth et. al. ( 2014a) and in Von Kalckreuth et. al. (2014b) with data from 2008 age has no effect on cash use but in Bagnall et. al. (2016) with data from 2011 the probability of cash use increases with age.

It is worth noting that age might be particularly vulnerable for including bad controls such as average cash holdings (for example Bagnall et. al. 2016, Aranago et. al. 2011, Arango et. al. 2015) or frequency of ATM cash withdrawals (for example Von Kalckreuth et. al. 2014a, and Von Kalckreuth et. al. 2014b). According to the ECB cash study (Esselink & Hernández, 2017) the amount of cash carried by euro area consumers increases sharply with their age, with consumers in the oldest age cohort carrying up to 43 euros more than those in the youngest age cohort. If people choose the level of cash use first and then withdraw money accordingly, and if old people carry on average more cash (that is, they have chosen to make a higher share of their payments in cash), no age effect will be observed if holding the average cash holdings fixed, even if it in reality exists. The same could possibly apply to ATM cash withdrawals. Von Kalckreuth et. al. (2014b) show that frequent ATM users are less likely to use cash, while old people are on average both more likely to withdraw cash at bank branches (so they are infrequent ATM users) and more likely to withdraw on average higher amounts of cash. Thus, controlling for the frequency of ATM cash withdrawals might hide the effect of age.

In conclusion, some evidence suggests that cash is more commonly used by old people, but also contradicting results exist, especially for Canada, Australia and Germany. Although including bad controls makes all coefficients harder to interpret, it is intuitively easy to see how particularly the coefficient on age could easily be biased in their presence.

Although age is one of the most commonly used regressor, most studies do not address the question of what lies behind the effect of age: the cohort effect or the age effect. The only study addressing this question is that of Von Kalckreuth et. al. (2014a). Their strategy is to use interaction terms for being old - if a cohort effect is at play, interaction terms would explain cash use, but if old people are just different from young people, then interaction terms would not have any effect. The authors also control for stated habit as an additional check to analyze whether habit affects peoples' choices. They find that all interaction terms except for one (old&employed) are insignificant, as are the coefficients for age and habit, and conclude that old people

pay more extensively with cash, not out of habit, but because they are different from young people.

I find there are a couple of weaknesses in their study. First, interaction terms would be significant only if old people react differently than young people to a certain factor, for example perceived risk, education etc. But this difference in reactions does not necessarily have to have anything to do with habit. An example of this would be a case where both young and old consider risk factors as important when making the payment instrument choice, and both consider cards to be equally risky with respect to fraud and loosing personal information. However, younger people, as they are more accustomed to using new technology, might still feel relatively safe and use cards despite the risks, while older people might feel a lot more vulnerable and therefore prefer cash. Thus, reacting differently to equal risk perceptions does not necessarily have to bee habit related but can be a completely rational and intentional choice. On the other hand, habitual behaviour would not necessarily show up as old people reacting differently to certain factors, especially if age and/or habit are included as controls. Assuming that people could identify some or all of their habitual behaviour and assuming that the effect of age is merely a cohort effect (that is, old people use cash due to habit), including controls for age and habit would capture all of the effect of habitual behaviour, leaving the interaction terms insignificant.

In Von Kalckreuth et. al. (2014a) neither habit nor age were significant. However, they defined habit as a dummy variable that equals one if respondents have indicated that familiarity and experience are important, and zero otherwise, but, as the authors bring out in a footnote, of those 44% who consider familiarity and experience important, only one third attach these attributes exclusively to cash. That is, 2/3 of the respondents attach these attributes either to cards only or to both cash and cards. Therefore, even if familiarity and experience were a determining factor in choosing cash for those who attach the attributes exclusively to cash, when the regressor is constructed in such a way that the statement can refer to either of the payment instruments, it cannot predict cash use (or card use for that matter), since for some a value of one for the dummy leads to cash use while for others it leads to card use. (In

Von Kalckreuth et al (2014b), who use the same dataset, and where habit was defined as familiarity being important and only cash fulfilling it, a positive association between habit and cash use was present). Also the interpretation of the coefficient on the age regressor is problematic. As already mentioned, the coefficient on age was not significant, but as Von Kalckreuth et. al. have included ATM withdrawal frequency as a control - that is, an outcome variable correlated with age as a control - it becomes difficult to interpret the coefficients and to draw any firm conclusions on the matter. Therefore, I would be very careful in drawing conclusions that old people use more cash just because they are different from young people based on this study only.

Some interesting insight into the cohort versus age effect problem can be gained from a study by Van der Cruijsen and Plooij (2015). Their descriptive statistics show that between 2004 and 2014 cash use (measured as the share of POS where cash is the most commonly used payment instrument) has decreased not only in all age groups but also in all age cohorts, with the biggest drop of 32 percentage points having occurred within those born between 1980 and 1989. This means that all age cohorts have decreased their cash use, although for the oldest age cohort (people born between 1940-1949) the drop has been only 7 percentage points. So younger people clearly seem to be open to bigger changes in their payment behaviour.

*Habit*

Psychological literature suggests that people's behaviour is affected by both habit and intention. According to behavioural studies, intentions are better predictors for actions that are performed occasionally, whereas regularly performed actions seem to be controlled by habits, even if the habits are in conflict with people's interests. It seems that habits provide an efficient default response, from which people can deviate if they are able and motivated enough. Thus, functions that are performed often, such as performing a payment, are mostly driven by habit rather than intentional behaviour. (Wood & Rünger, 2016.)

Habit formation starts with people first performing intentional acts. If these intentional acts are rewarded, that is, if people attain their goal, people tend to repeat them. Each repetition strengthens cognitive associations between context cues and the response. With time, people react to context cues and perform the familiar action without giving it any thoughts or having any intentions. Sometimes, when internal cues are strong and unambiguous, people recognise that their behaviour is driven by habit. Most of the time however, as people are not very good in recognising their habitual behaviour, they interpret their intentions by observing their own behaviour and the context it is performed in, and produce post hoc explanations for their behaviour. As habitual behaviour is much faster to process and easier to perform than learning new behaviours, people tend to favour habits. Being favourably disposed toward habits, people may infer that they intended to perform the response. (Wood & Rünger, 2016.)

As making payments is a very regularly performed action, it is likely that it is, at least to some degree, driven by habit. Applying the theory in the context of payment instrument choice, it is likely that initially a cost benefit analysis on payment instrument attributes has been performed, leading to intentional behaviour in choosing the payment instrument. After a while, however, people would merely react to context cues instead of performing intentional behaviour. Here, context cues could be factors specific to a payment situation, that is, factors such as the type of POS, the amount of money in the wallet and maybe even the transaction value. When asked about the reasons for behaviour some might identify they act out of habit while others do not and try to interpret the reasons by observing their behaviour. Some might remember the original reasons for making their payment instrument choice and state them as reasons, even if they did not hold true anymore, while for others ease of use and speed could potentially also seem as good explanations, as sticking to old familiar payment habits feels mentally easier and faster than diverging from habitual behaviour. Sometimes valuations on attributes might change, for example a need for controlling overspending might arise, provoking new intentional behaviour and leading to changes in payment behaviour and in reasons driving it.

Empirically, disentangling the effect of habit from that of intentional behaviour is difficult, as usually only the behaviour is observed but not intentions. Additionally, assuming that intentional behaviour reflects preferences, it is possible that preferences and habit are in contradiction, that is, people behave out of habit in a way they do not want to behave, or habit and preferences can be in line with each other, that is, people behave out of habit in a way they would prefer to behave. Disentangling the effect of habit from that of intentions is particularly tricky in the latter case. Different strategies to study habit have been used.

In some studies a dummy for stated habit is used. Von Kalckreuth et. al. (2014b), for example, find that cash use in Germany is higher amongst those who state that familiarity is important and only cash fulfils it, while Van der Cruijsen and Van der Horst (2016) find that the probability of paying electronically in the Netherlands is higher amongst those who state to have a habit of paying electronically. In Von Kalckreuth et. al. (2014a) habit had no effect on the payment instrument choice, but in their study familiarity was not specifically attached to either cash or cards, and it is likely that some attached it to cards (see the chapter on age), in which case a dummy value of one could lead to opposing payment instrument choices.

As people are largely unaware of the cuing mechanism that activates habit, only part of the habitual behaviour is recognised. Therefore, stated habit can capture only some of the effect of habit. Another strategy used to study whether payment instrument choice is determined by intentions or habit is to check what happens to the behaviour when some of choice-determining factors change. Two studies have used this type of strategies.

One is that of Van der Horst and Matthijsen (2013). They performed a virtual reality study in which financial incentives, risks and other factors differed among participants to test the hypothesis that payment instrument choice is a form of habitual behaviour rather than a rational choice[9] and, thus, cannot easily be manipulated. They

[9] The authors talk about rational decision making versus habitual behaviour but habitual behaviour does not necessarily mean irrational behaviour. It can be argued that also habitual behaviour is rational, as it

manipulated factors such as risks associated to cash, risks associated to cards, need to control the budget, extra fees for paying with card, changes in pricing (round versus non-round prices), prominence of a payment terminal, and time pressure etc., and found that these manipulations could explain only 20% of the variation in the use of cash. The authors interpreted this as evidence for the payment choice not being a conscious one, but instead a largely habitual one that cannot be easily influenced. The problem with virtual reality studies is that people might behave differently in a game environment than they would in real life. Additionally, authors equate habit with the part of variation that the variables did not account for. It could, however, also be the case that the "sticky behaviour" is due to very strong preferences for one of the payment instruments due to costs or benefits that were not controlled for in the experiment.

Another one is that of Kosse and Jansen (2013). They study the effect of foreign background (or the effect of a change in the environment) on payment instrument choice and they find that, in the Netherlands, first generation migrants from non-western countries are more likely to use cash than people with Dutch background. Especially prone to use cash are those migrants that come from countries that can be classified as cash oriented compared to Netherlands. The effect does not exist for second-generation migrants who seem to be similar to people with Dutch background. The results indicate that old payment habits stick, even when the environment changes to support a different kind of behaviour, but that payment behaviour is not passed on between generations. However, a potential problem with the study is that, according to descriptive statistics, a higher percentage of people with foreign background do not have an account. Without an account, one cannot have a card. If the difference in account ownership is due to first generation migrants having poorer access to accounts, the differences in payment instrument choice could just be a reflection of differences in access rates. On the other hand, if the difference in account access rates is due to own choice, it could either reflect people sticking to old habits

would be costly to use a lot of energy in making a deliberate choice each time a payment situation is encountered, or because the expected benefit from starting to use a new payment instrument might not exceed the cost of learning to use it.

and not wanting to get accounts as they have never had them, or it could reflect learning costs associated to adopting and using new services (accounts and cards) and therefore be an intentional decision.

A third strategy used is the one utilized by Von Kalckreuth et. al. (2014a), in which interaction terms between old age and other factors were used to check whether old people use more cash due to cohort effect, that is, habit, or due to just being different from young people. They conclude that it is old people being different rather than habit that explains why old people use more cash. However, there are some weaknesses in the strategy they use (see the chapter on age), which is why the evidence does not seem convincing enough to draw any conclusions.

A fourth strategy is to exploit the possible discrepancy between habit and preferences. Van der Cruijsen, Hernandez and Jonker (2017) study the gap between stated preferences, stated behaviour and actual behaviour within Dutch consumers. They find that approximately 70% of respondents state preferring debit cards. However, one third of the respondents, while stating to prefer debit card, actually pay the majority of their payments with cash. This means that approximately one third of all respondents, and half of those stating they prefer debit card, overestimate their use of debit card. The likelyhood of overestimating the debit card usage depends both on demographic and on payment specific factors. Old people, people with higher education and people with higher income were more likely to overestimate their debit use. According to authors, this age effect supports the idea that the discrepancy between preferences and actual behaviour is at least partly explained by the habit of paying cash. The discrepancy between preferences and behaviour in high income and highly educated people is explained by them being more likely to follow trends and use new payment instruments, and thus reporting a preference for them, but then, if they still have both cash and a debit card in their wallet they might stick to the unconscious habit of making payments with cash. Payment specific factors that affect the likelyhood of overestimating debit use include average transaction size, type of POS and amount of cash in the wallet: overestimation of debit use is more common amongst those who on average paid smaller amounts, when shopping at stores with relatively high share of

cash payments, such as street vendors, the catering industry, culture etc., and when people had high amounts of cash in their wallet in the morning they filled the payment diary. The finding that people overestimate their debit use in the presence of these particular payment specific factors is well in line with the idea that these factors might function as context cues, triggering (unintentional) behaviour.

Van der Cruijsen and van der Horst (2016) deviate from the usual research framework for payment instrument choice, and construct a conceptual socio-psychological model where the payment behaviour is explained by habit, intentions and whether the consumer has a real choice in the payment situation, that is, whether all instruments are accepted etc. In their model, payment intention is determined by attitude, which is formed using perceived attributes, and other socio-psychological factors such as social norms, roles, emotions and perceived control. They find, using a Dutch data from 2015, that socio-psychological factors explain payment attitude, intention and behaviour well. Although payment intentions are the key driver of payment behaviour, payment habits also play an important role in explaining how consumers pay. The role of actual control over the payment situation, like having enough money in the wallet when you want to pay cash, or not experiencing technical disturbances when you want to pay electronically, is limited.

In conclusion, psychological literature suggests that repeatedly performed actions such making payments are mostly driven by habit rather than by intention. As it is difficult to disentangle the effect of habit from that of intention on payment instrument choice, the matter is very difficult to study. Many different strategies have been used to study the issue, and all but one study suggest that habit indeed affects the payment behaviour. In my opinion, the most successful, that is, the least controversia, strategies include using stated habit as a regressor, and studying the gap between stated preferences and actual behaviour. These strategies, however, capture only part of the effect of habit, as people are not always aware they act out of habit, and as habit and preferences are not necessarily always in conflict with each other. Although some of the studies have weaknesses that make it difficult to draw any conclusions based on

their evidence, I think the idea that habit drives payment behaviour at least to some degree does get enough support for the idea not to be rejected.

#### 4.2.3 Adoption

As it is possible that different factors drive cash use for those who own a card and for those who do not own a card, it would be interesting to study the drivers of cash use for these two groups separately. Unfortunately, research on the adoption decision is scarce. Higher card adoption rates have been associated with awareness (Hyytinen and Takalo 2009), positive perceptions on payment instrument attributes of cards (Stavins 2013, Van der Cruijsen and Plooij 2015) and demographic factors such as high income, high education and young age (Hyytinen and Takalo 2009, Van der Cruijsen and Plooij 2015).

#### 4.2.4 Theory in light of the empirical evidence

The evidence from the empirical literature seems to support the behavioural predictions of the models: people react to financial and time incentives, and the needs for expenditure control. Additionally, according to the empirical studies, cash use is negatively correlated with transactions size and income, and positively correlated with the amount of cash in the wallet, while liquidity constrained people with high information storing and processing costs are more likely to use cash. However, particularly the facts that cash use is negatively correlated with transaction size and income, and positively correlated with the amount of money in the wallet, are not very surprising, as the models are probably inspired by real life behavioural observations. Therefore, to analyse the relevance of the models it is more interesting to check whether the model assumptions hold.

First, the transactions size model by Whitesell (1989) and the inventory model with cash-credit choice by Alvarez and Lippi (2017), although leading to different payment

behaviour, are both based on the idea that card transactions are more expensive than cash transactions, either in terms of transaction time (both models) or in terms of cash discounts foregone (the Whitesell model only). According to cost studies, in many countries cash transactions are indeed faster than card transactions. This is, however, not the case for all countries. For example in Denmark, the difference between transaction times of cash and card payments is negligible. (Kosse et. al., 2017; Jonker, 2013; Schmiedel et. al. 2012; Danmarks Nationalbank, 2011.) There is less information available on cash discounts, but according to McAndrews and Wang (2012), they exist at least in the US. Thus, the models seem relevant in explaining cash use in some countries but not in all. However, as the interest rates have been very low since the financial crisis of 2008, the relevance of these models with respect to cash costs is not very good anymore.

Second, the income model by McAndrews and Wang (2012) is based on the assumptions that cards incur fixed adoption costs and pecuniary transaction fees proportional to the size of the purchase, while also cash incurs pecuniary transaction fees proportional to the size of the purchase, but one that is higher than the transaction fee for cards. As was discussed earlier, it is common that cards incur fixed adoption or maintenance fees, but less information is available on card related pecuniary transaction costs. Debit card surcharges have been allowed in the Netherlands, the UK, parts of the US and Australia, whereas for example in Canada they have not been allowed. However, there can be other type of restrictions, such as limitations on the number of free card transactions. With respect to transaction fees, the model of McAndrews and Wang (2012) seems relevant for some countries. However, the model builds on the idea that cash incurs higher pecuniary transaction costs than cards, or otherwise no-one would ever use cards (as these pecuniary transaction costs are the only costs cash incurs in this model). It is very difficult to come up with what type of costs these could reflect, as I doubt any shop anywhere in the world would charge people extra for paying their purchases with cash. A potential source for pecuniary cash related costs are fees for ATM cash withdrawals (cash withdrawals at bank branches are usually free of charge). According to the ECB cash study, for example, depending on country, between 6 to 63% of people stated that

they at least sometimes pay ATM withdrawal fees (Esselink & Hernandez 2017). However, to make ATM cash withdrawals you need a card, that is, you will pay the fixed card adoption or maintenance fee anyway. But if you pay it, then, if transaction costs related to cash are higher than those related to cards, it would be cheaper to use cards. Thus, the assumption that cash incurs pecuniary transaction costs proportional to the amount of payments made in cash does not seem plausible, and so the model does not seem relevant in explaining the choice between cash and cards.
Additionally, McAndrews and Wang assume that some merchants accept only card payments and charge higher prices than equivalent merchants accepting cash only. This assumption does not seem very relevant, at least yet, as these type of merchants would be very rare exceptions.

The liquidity monitoring model by Von Kalckreuth et. al. (2014b) is based on the observation that, as cash incurs withdrawal and opportunity costs that could be avoided if using cards, cash has to have some features cards don't for people to use cash. They suggest that the tangible form of cash makes it a more efficient tool than cards for monitoring liquidity. They suggest that it is liquidity constrained people with high information storing and processing costs that will benefit from these attributes of cash and use it. According to their study, this is indeed what seems to happen. Unfortunately the matter has not been studied in any other studies, but Hernandez et. al. (2017), do find that people who find it financially difficult to get by (that is, liquidity constrained people) are more likely to make their payment instrument choice with expense monitoring needs I mind.

In conclusion, the models by Whitesell (1989), Alvarez and Lippi (2017) and Von Kalckreuth et. al. (2014b) seem relevant for the majority of countries, whereas the model by McAnrews and Wang (2012) seems less relevant, as it is based on cash related costs that, according to existing evidence, do not exists.

#### 4.2.5 Potential problems in comparing and interpreting the empirical studies

As was discussed in the beginning of the literature review, comparing the relevance of specific regressors between studies is not problem-free, as the research questions, and controls and measures used usually differ between studies. These are not the only factors that might affect the interpretation and comparison of results.

First, it is common that the definition of a specific regressor differs across papers, which might complicate the comparison. As an example, many papers include a regressor reflecting security, but the actual survey question can ask people to rate either perceived safety or perceived risks related to a specific payment instrument, or it can ask people to rate the importance of safety or risks in general, with potentially including examples that might refer to either one payment instrument or the other, or to both instruments. What is more problematic, it seems that sometimes the definitions are so ambiguous that it is possible that the researchers and the respondents talk about different things. Additionally, it seems that researchers sometimes have some idea on how people think - they might for example assume that all people attach a specific attribute to the same payment instrument, when in reality this is not necessarily the case - and become careless in constructing the regressor (an example would be controlling for the importance of a specific attribute in a general case, that is, without attaching it to a specific payment instrument). This could lead to biased results as the regressor does not measure what it is thought to measure.

Second, many papers include bad controls, that is, outcome variables as regressors, which might bias or at least complicate the interpretation of the coefficients on other regressors. Additionally, bad controls do not "explain" the outcome variable, they just measure the same phenomenon and are therefore correlated with it. For example, the fact that the amount of cash in the wallet is positively correlated with cash use does not necessarily mean that having cash in the wallet would be a driver of cash use as it is possible and quite likely that people choose the level of cash use due to other factors and then accommodate their cash withdrawal behaviour to match the preferred level of cash use.

Third, people might have different reasons when they make a decision on whether to adopt a card or to stick to cash only, and when they decide on which instrument, cash or card, to use each time they make a transaction, that is, the intensity of use decision. Some studies abstract from the adoption decision by including only those respondents who have at least one card, while others study separately the adoption decision and the intensity of use decision. A third group of papers study only the intensity of use decision but include both those with card and those without a card. The results in this latter case might be a little biased since they could actually be capturing some factors determining the adoption rather than the intensity of use decision. Depending on the country, the adoption rate of at least one card varies to some degree (see Cart 1), so the size of the possible bias will vary as well.

Fourth, the studies use different types of data, such as payment diaries, surveys and scanner data. The accuracy of the data depends on the way the data has been collected, with scanner data recording the purchase behaviour being the most accurate (although restricted to specific type of purchases such as grocery store purchases) and surveys being the least accurate, as they rely on the self assessment of behaviour. The accuracy of payment diary data is relatively good, as it covers all type of transactions and is based on (self-)recorded behaviour. However, the accuracy of payment diaries depends on the length of the payment diary. People tend to forget small value cash purchases and the forgetfulness increases the longer the recording period. One-day payment diaries have been found to be the most accurate ones. (Jonker & Kosse, 2013). The diary lengths in studies included in this literature review range between one to eight days. Therefore, it is possible that the results in some of the studies are biased, as part of cash purchases have been left unreported.

In addition to these factors complicating the interpretation and comparison of the results in different studies, certain methodological choices are open for critique. First, several papers run multiple regressions (for example, Wakamori & Welte, 2017; Van Kalckreuth et. al. 2014a & 2014b; Hernandez et. al., 2017) but problems related to multiple hypothesis testing are not discuss nor corrected for. Second, most studies

include over 15 regressors so it is very probable that some of the significant results are "false positives", that is, certain true null hypotheses are rejected (type 1 error). Third, most empirical studies lack a theoretical framework that would explain how the regressors should affect the payment choice. This is problematic at times, as then any result (positive correlation, negative correlation, or no correlation) seems meaningful and it is easy to come up with post-hoc explanations on what the findings stand for.

In addition to these problems, it is also worth noting that a mere correlation does not necessarily stand for a causal relationship. Additionally, as most of these studies use data from around 2010, whereas new payment innovations such as contactless card payments and mobile phone applications for making person-to-person transactions have become available after this, the findings might be becoming obsolete.

### 4.3 Limitations of the current literature

As was previously mentioned, the empirical literature, like the theoretical literature, focuses solely on analysing the choice between cash and cards for the use of POS transactions. However, cash is also used for P2P transactions, and as a store of value or for precautionary purposes. Although no empirical studies on drivers of cash use for these purposes exist, the ECB cash study from 2016 shows that, on average, 24 % of the euro area citizens keep cash outside a bank account as precautionary reserves or as an alternative way of saving, with the figure ranging between 15 % (in France) and 40 % (in Slovakia) (Esselink and Hernandez, 2017). Thus, holding cash reserves for store of value or precautionary purposes is relatively common. Additionally, people reported that they get cash replenishments, that is P2P transactions, from family, friends, and colleagues on average 13 times per year, with the average value of this type of replenishment being 25 euros each (Esselink and Hernandez, 2017). This figure probably does not include P2P transactions for payments made at flea markets etc., as it refers to cash replenishments from family, friends and colleagues. Thus, the figure for P2P transactions is probably bigger than this.

As the reasons for using cash for P2P transactions, and for store of value or for precautionary purposes have not been studied, they can only be speculated. Traditionally the substitute for cash in P2P transactions has been credit transfers initiated using Internet banking services or cheques.[10] However, cash transactions are a lot faster and easier to make than credit transfers or cheque payments, as long as one has enough cash on hand and no change is needed. Additionally, cash payments are settled immediately, whereas credit transfers usually take a day or two before the recipient receives the money and cheques also acquire time and effort to be redeemed. The immediate finality of cash transactions is something that is potentially valued highly, particularly in P2P transactions that occur between two persons that do not know each other, for example, when paying for purchases at flea markets etc. Therefore, cash has probably traditionally outperformed credit transfers in P2P transactions. However, the new mobile phone applications for making P2P transactions that have emerged in several countries during the 2010's have made sending money to other people as easy as sending a text message. Although it usually still takes a day or two for the money to reach the account of the recipient, the recipient will usually get a notification informing that money is on its way, making this payment method a good alternative for cash also in P2P transactions where the two parties do not know each other. Therefore, it is possible that although cash might have dominated P2P transactions this far, with the emergence of these new mobile phone applications for making P2P transactions, cash might be loosing some of its appeal as an instrument to make P2P transactions with.

As checking accounts often yield interest it would seem rational to hold money on a checking account rather than keeping it in the from of cash. Even if no interest can be earned, cash, unlike money on a checking account, bears the risk of theft. Still, according to the cash study of ECB, people hold money in the form of cash for precautionary and store of value purposes. Why could this be? I can come up with a couple of scenarios in which people might prefer holding money in form of cash rather than as electronic balances at bank accounts. First, if there is mistrust towards the banks or the governments, people might find it more secure to keep their wealth in

[10] This service might not have been available in all countries.

form of cash and store it outside the banking system. Second, the negative central bank interest rates together with the discussion on replacing cash with central bank issued electronic currency with the aim to this way being able to impose negative interest rates also on consumers might give rise to mistrust on the central banks and lead to some consumers preferring cash over electronic bank account money.

### 4.4 Summary

The empirical literature identifies several factors that might affect the payment instrument choice. Most of the ideas in the theoretical models get supported. People seem to react to financial and time costs, and expense monitoring needs. Additionally, cash use decreases with income and transaction value, and increases with cash holdings and the need to monitor liquidity. Three of the four models seem relevant, at least for some countries, where as one, the model by McAndrews and Wang (2012), seems less plausible due to it building on cash related costs that do not exists.

Additionally, the empirical literature suggests that certain type of behaviour might be explained by other reasons than those suggested by the theory. For example, some of the negative correlation between cash use and transaction size could be due to people unconsciously spending more when they use cards, either because cash use has a restrictive effect on spending behaviour, or because when using card, one is not constrained by the amount cash one has in the wallet. The fact that cash is not only efficient for controlling for overspending due to it facilitating monitoring the amount left to spend but also because it might have a behaviour restricting effect could also partly explain its popularity as a tool for expenditure control.

Other drivers of cash use recognised by the empirical literature include perceiving cash easy to use or safe, making payments at certain type of stores, old age (to some degree), low level of education, and habit. Anonymity, although often considered as an advantage of cash, does not seem to explain cash use very well.

In addition to demand side factors, cash use could be explained by supply side factors such as restrictions on card adoption or merchant card acceptance. Low merchant card acceptance seems to explain some of the cash use, although it is a problem for card use in higher value purchases rather than lower value purchases, as it seems that people would use cash for small value purchases anyway. Card adoption rates vary by country but unfortunately there is no information on whether the non-adopting is voluntary or due to restrictions to access.

The adoption of cards is an interesting question of its own, as drivers of cash use might differ when making the choice on whether to adopt a card or not, and when choosing which instrument to use when making a payment (the intensity of use decision). Unfortunately card adoption decision has not been studied that extensively, but the existing results are in line with the intensity of use drivers, to the extent they have been studied.

Comparing results between different studies is not problem-free as there are many complicating factors. In addition to studies addressing different research questions, including different controls, and using different definitions for specific controls, the interpretation and comparison of results can be complicated by, for example, differences in the type of data, differences in the research population (card adopters versus both card adopters and those who have not adopted a card), including bad regressors et cetera. Therefore, it is best to treat the results of this empirical literature review as suggestive.

A noteworthy limitation of the current literature on drivers of cash use, both theoretically and empirically, is that only factors affecting payment choice at point of sale have been studied. However, drivers of cash use for person-to-person transactions or for store of value purpose could be different from these ones.

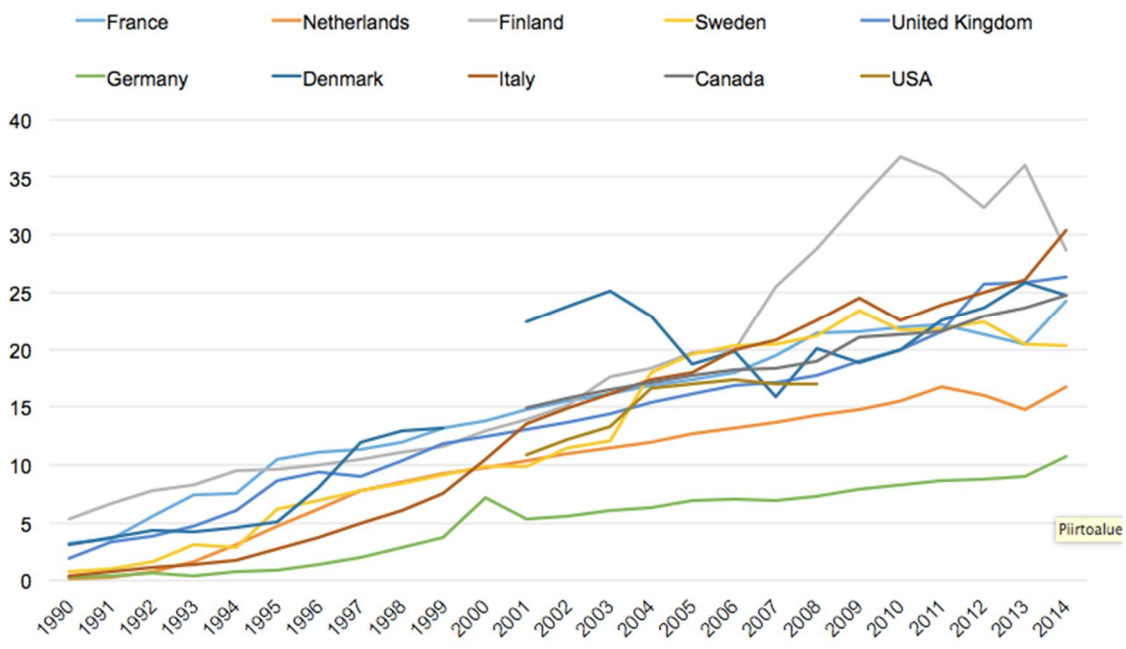
# 5. Case Finland

## 5.1 Finland and other Nordic countries as forerunners

The Nordic countries are often considered as forerunners in electronic payments (Reuters, 2015). The wide use of electronic payments in these countries has been attributed to banks having been early promoters of electronic payments, for example by making it easy and cheap to use cards (The Economist, 2016). For example in Finland, banks imposed fees for using cheques in 1988 while at the same time cards were vigorously marketed with debit card transactions being free of charge. Additionally, cards were quite widely accepted. According to the Finnish Bankers' association, in spring 1987 debit cards were accepted by most retailers and service providers while the acceptance of credit cards ranged between 4 000 and 30 000 points of sale depending on the card in question. One reason for high card acceptance was that accepting card payments was relatively cheap for merchants. Also, the first EFTPOS terminals (electronic funds transfer at point of sale) were introduced in 1985 at fuel dispensers in gas stations and at the counters of department stores. These terminals had a magnetic stripe reader and they were based on an offline batch transmission system. The new payment terminals made card payments three times faster compared to using the old imprinters. It has been estimated that by the end of 1989 there were already between 10 000 and 15 000 EFTPOS terminals in Finland. The growth rate of these terminals was the fastest in the world at that time. (Malkamäki and Tanila, 1990.) Even today, card acceptance in Finland, measured as the number of EFTPOS terminals per thousand inhabitants, is one of the highest in the world (Chart 3). The card acceptance rates reported in the 2016 ECB cash study (Chart 2) confirm this, with Finland having the highest card acceptance rate in the euro area. In Finland 89 % of all stores accepted card payments in 2016, whereas the Euro area average for card acceptance was only 72 %. Also card adoption in Finland is among the highest in the Euro area, with close to 100 % having adopted a card (98 % according to a study by Finnish Competition and Consumer Authority, Raijas and Saastamoinen 2015), whereas the Euro area average is 93% (Chart 1). The difference in card use is even higher than that of card adoption. For example in 2016, card payments in the Nordic countries (and Canada and the US) ranged between 280 and 330 payments per

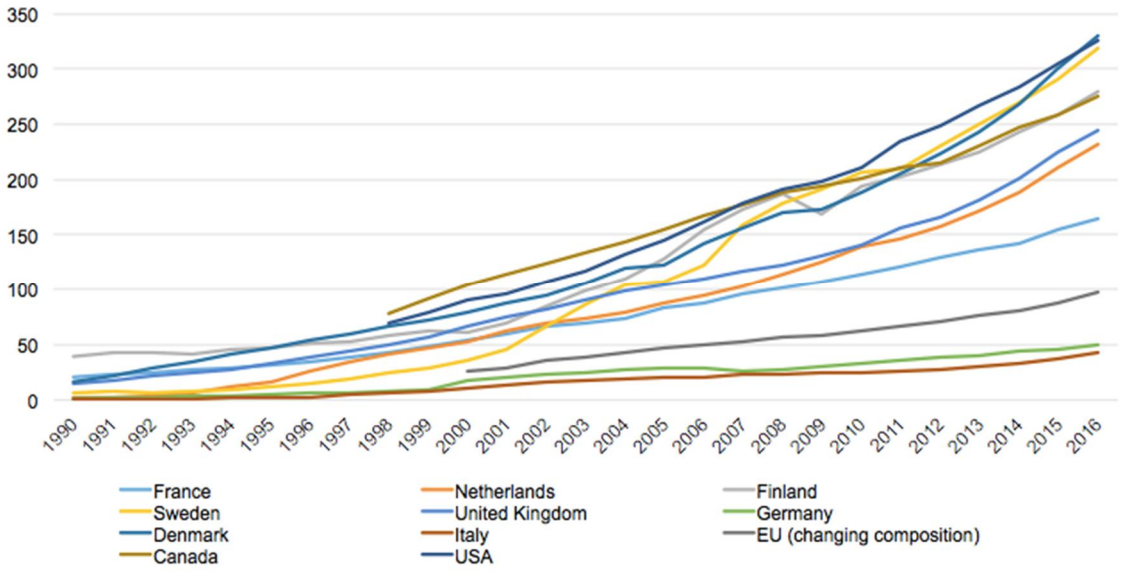
inhabitant while the EU average was 97 card transactions per inhabitant (Chart 4). Interestingly, the number of card payments is a little lower in Finland than in Sweden, Denmark and the US, although infrastructure wise there should be more terminals in Finland than in these countries. Unfotunately there is no data on card adoption and acceptance rates from Sweden and Denmark, but for example in the US card adoption rate is only 88 % (Chart 1) and in Canada, for example, card acceptance rate is only 73 % (Chart 2). One potential explanation might be that the card payment figures include all card payments, that is, payments at point-of-sale and remote card payments, i.e. Internet purchases paid by with cards. As cash cannot be used to make payments on the Internet, the remote card payments should not be included in the card payment figures. If the share of remote card payments of all card payments was constant across countries this would not be so problematic. However, payment instruments for Internet purchases vary between country - in some countries, cards are the main instrument for making Internet payments, while in other countries, such as Finland, e-purchases are often paid by with credit transfers and so the share of POS card payments in these figures might be higher for Finland than in some other countries.

Chart 3. Number of EFTPOS terminals per thousand inhabitants




Source: BIS, ECB(b).

Chart 4. Number of card transactions per inhabitant




Source: BIS, ECB(b).

## 5.2 Costs

Costs of cards

Card transactions at points of sale have always been free of charges in Finland. There used to be a threshold value of 30 marks for card transactions but the restriction was removed in 1998 (Finnish Competition and Consumer Authority, 1998). Debit cards have traditionally been free of adoption and maintenance fees for people under 26 years of age. After that, people pay monthly or yearly maintenance fees, although some card issuers, for example S-Pankki, offer credit cards free of yearly and monthly charges to all age groups. (Hyytinen and Takalo 2009, Nordea, OP, Danske, S-pankki.) Thus, cards are free of any charges until the age of 26, after which most cards incur fixed monthly or yearly maintenance fees, but transaction fees do not exist for POS transactions.

Costs of cash

In Finland, cash can be acquired at bank branches, at ATM's, and, in recent years, as cash-back at certain grocery store chains. According to a study by the Finnish Competition and Consumer Authority (Raijas and Saastamoinen, 2015), for 93 % of Finnish consumers the most common way to obtain cash is to withdraw it from ATM´s,

while 5 % say they most commonly obtain cash from a bank branch. Two per cent of Finnish consumers do not withdraw cash at all. There is no historical data on the channels of withdrawing cash, but according to Hyytinen and Takalo (2009) it seems that most cash was obtained via ATM's already in the 2000's. Currently, there are two main operators offering ATM's in Finland, Automatia (Otto-ATM's) and Nokas (Nosto-ATM's) (Automatia 2018, Nokas 2018). Otto-ATM's had a monopoly from 1994 to 2008, and withdrawals from these ATM's used to be free of charge. In 2010's several banks have started to offer only four to five free withdrawals per month after which they charge between 40 cents and 1 euro per withdrawal. One bank, Ålandsbanken, charges 80 cents per each withdrawal below 80 euros. However, according Nordea, one of the biggest banks in Finland, most of their customers are not affected by the limitations as they only make one to two withdrawals per month. (Mankinen, 2017.) Cash withdrawals from bank branches have always been free of charge whereas the cash-back services are also free of charge but most stores demand you to make a purchase to be able to withdraw cash. Although most Finns probably don't pay withdrawal costs, acquiring cash incurs "shoe-leather costs", that is, the time and "nuisance" cost of walking or driving to an ATM, bank branch or store and making the withdrawal.

There is no time series data on checking account interest rates in Finland, but average deposit interest rates have been between 2 % and 4 % between 1995 and 2008. Since then the average deposit interest rates have fallen and have been close to zero since 2012. As checking accounts yield lower interest rates than savings accounts, it is likely that interest rates on savings accounts have been very close the zero the majority of the 2010's. A quick look at checking account interest rates in Finland in May 2018 shows that a few banks offer a yield of 0,1 % while the majority of banks offer a zero yield. (Bank of Finland (a), Nordea, OP, Aktia, Danske, Handelsbanken, S-Pankki.)
Cash is also vulnerable to theft. Thefts are relatively rare in Finland compared to many other countries (The Active Times, 2014). However, the risk of being robbed seems to depend on age, or at least the media writes mostly about robberies concerning old people (for example, MTV 2010, Aamuposti, 2016, Ilkka 2016).

## 5.3 Transaction time study

The models of Whitesell (1989) and Alvarez and Lippi (2017) rely on the idea that cards incur higher transactions costs in terms of transaction time. Transaction times of payment methods, however, vary considerably across countries (for example Schmiedel et. al., 2013). To check the relevance of these models in the Finnish context it is crucial to know whether this assumption holds, which is why I will conduct a transaction time study.

I will follow, where applicable, the example of a time duration study conducted by the Bank of Canada in 2014 (Bank of Canada, 2017). The Bank of Canada time duration study covered 5891 transactions in 29 stores from Montréal, Toronto and Ottawa, to avoid potential regional biases. Since transaction time might vary with the size and type of store, the sample consisted of a wide variety of locations, such as gas stations, cafes, supermarkets, convenience stores etc. The sample was also split on all seven days of the week and on different times of the day from early morning till late evening. Observation time per each store was 6 hours. Due to time and resource constraints, the scope of this study will be smaller. The data was collected in Helsinki during April and May in 2017. To account for the possibility of transaction times differing by the type of store, the sample includes supermarkets and cafés. The idea is that supermarkets represent the type of stores where payment terminals have been available for a long time so people are used to use cards there, the transaction sizes are relatively high and the payment terminals should be quite efficient. Cafés represent small stores with low value purchases and potentially less efficient payment terminals. The observations were collected on four separate occasions, with two visits to a supermarket and two visits to a café. The total observation time was 7 hours. To account for potential differences in the clientele throughout the day, a concern especially in supermarkets, one super market observation session was held at noon while the other was held in the evening. One of the observation sessions at cafés was held in the afternoon, while the other was held in the evening. In total, the sample includes 237 observations of which 37 are from cafés and 200 are from supermarkets. The share of cash transactions in this sample was 24%.

In the study by Bank of Canada the transaction duration was defined as the number of seconds between the moment the total sum to be paid was made known to the customer and the moment that the receipt and billing slips were printed and taken out of the register. This seems to be a common way to define the transaction duration in cost studies, probably due to the focus on costs of payments to retailers as well. However, since one reason to use cards might be the desire to avoid the fuss of handling change, I find it more suitable to define the transaction duration as the time between the moment the total sum to be paid is made known to the customer and the moment the customer has slipped the payment instrument into his wallet (or, alternatively, into his pocket or bag).

Only cash and card payments are included. In supermarkets, consumers have the option to use a loyalty card. Since this will extend the duration of the transaction but is not of interest in this study a dummy is included to indicate if the loyalty card is used after the transaction sum is stated. Sometimes the loyalty card property can also be attached to the actual payment card. Unfortunately it was impossible to distinguish between an ordinary card transaction and a transaction where this type of card was first used to collect loyalty points and then to make the transaction, leading this type of transactions being registered as ordinary card transactions. This might bias the estimate for card transaction time upwards.

Sometimes consumers have coupons that entitle them to discounts, which they hand in only after the transaction sum is stated. In these cases, only if the new discounted transaction sum is verbalized, the transaction is included in the study, with the transaction time starting form when the new discounted price is made known to the customer. If the transaction is interrupted by some activities unrelated to the transaction, such as the cashier starting to serve other customers during the transaction by answering their questions, the transaction is excluded from the study. It is worth noting, however, that the cashier starting to serve other customers during the transaction was something that only slowed down cash payments, since card payments do not require the presence of the cashier once the payment event has been initiated.

In addition to transaction time, factors logged during observing were the payment method used, estimated age and whether the consumer used a loyalty card. In case the payment was made with card, the information on whether it was a PIN transaction or a contactless card transaction was recorded. If the consumer intended to make a contactless card transaction but was required to use the PIN code, the transaction was recorded as a PIN transaction. This might bias the transaction times of contactless card transactions downwards and the PIN card transactions upwards, but since it was difficult to distinguish between the two from distance, all transactions where the PIN code was used were recorded as PIN transactions.

In the manner of the Bank of Canada transaction duration study, to account for potential skewness in the distribution of the transaction durations, I will use a quantile regression model to estimate the median transaction time, instead of estimating a mean with an ordinary least squares model. Covariates included in the model are the method of payment, together with dummies for using a loyalty card, making a contactless card payment, type of store, and being over 60 years. The age variable reflects a subjective estimate of age based on the appearance. It is included to account for the possibility that older people are slower in their movements and more prone to use cash, which, if the age distribution of cash users in the sample does not reflect the age distribution of cash users in the total population, could bias the transaction time of cash. The results of the quantile regression are presented in Figure 3, Panel A.

The estimated median transaction times for PIN card transactions and cash transactions were 10,7 seconds and 19,1 seconds, respectively, indicating that card transactions are faster than cash. Contactless card transactions are even faster with a median transaction duration of 7,4 seconds. This result differs considerably from results in other transaction duration studies. The Bank of Canada time duration study, for example, found that cash transactions are the fastest with a median duration of 11,61 seconds, while contactless card transactions take about 15 seconds and PIN and swipe transactions take almost 26 seconds (Bank of Canada, 2017). A study by the Federal Reserve Bank of Australia (Stewart et. al., 2014) also found cash (25 seconds) to be faster than PIN and signature authorization card payments (approximately 35 seconds), with contactless card payments being fastest (20 seconds). The closest come

the results from Denmark where cash and card transactions took almost the same time, with the average cash transaction taking 14,3 seconds and the average card transaction taking 14,9 seconds (Danmarks Nationalbank, 2012). One reason for differences in the results could be due to the definition of the transaction time: in this study, the transaction does not end once the receipt is printed but instead when the payment instrument has been slipped into the wallet. This lengthens the time of cash transactions since it usually takes more time to slip in the notes and coins received as change than a single card. Also, in some places the card can be removed from the payment terminal before the receipt is printed, whereas with cash payments the cashier often gives the receipt together with the change, lengthening the cash payments in this way as well.

Figure 3. Estimated transaction time by quantile regression.

| Panel A | coefficients | lower bound | upper bound | Significant at 5% level |
|---|---|---|---|---|
| (Intercept) | 10,7 | 9,8 | 11,8 | |
| cash | 8,4 | 5,8 | 9,3 | * |
| plussa | 8,5 | 6,0 | 11,3 | * |
| NFC | -3,3 | -5,1 | -2,6 | * |
| old | 5,2 | 3,8 | 8,5 | * |
| store_type | -1,0 | -2,5 | 0,5 | |
| Panel B | coefficients | lower bound | upper bound | Significant at 5% level |
| (Intercept) | 10,6 | 9,8 | 11,7 | |
| cash | 8,7 | 7,6 | 10,1 | * |
| plussa | 8,3 | 6,3 | 10,9 | * |
| NFC | -3,7 | -4,8 | -2,9 | * |
| old | 5,2 | 3,7 | 8,4 | * |
| store_type | 0,0 | -1,2 | 1,0 | |
| cash:store_type | -8,5 | -12,2 | -2,6 | * |

The dummy for store type suggests that transactions at cafes might be a little faster overall, although the effect is not statistically significant at 5% significance level. The expectation regarding the type and direction of the effect the type of store might have on the transaction time was that transaction times of cash would be fairly stable whereas the transaction times of card payments might vary. Surprisingly, while recording observations it turned out that it was the transaction time of cash that

varied considerably between cafes and supermarkets, whereas for cards transaction times remained fairly stable, with card transactions at supermarkets being potentially a little faster. One possible reason for this could be that in supermarkets the authenticity of bigger notes such as 50 euro notes were always checked with a machine. Hence, an interaction term for cash use in cafes would be more suitable than a dummy for transaction location to account for the heterogeneity in transaction times across transaction locations. The results with an interaction term are presented in Figure 1, Panel B. The median transaction time for a PIN card transaction is now 10,6 seconds while the median cash transaction at supermarkets takes 19,3 seconds. In cafes, cash transactions are approximately 8,5 second faster than they are at supermarkets. The difference is statistically significant at 5% significance level. The estimated median cash transaction at cafes (10,8 seconds) is a little slower than the median estimated card transaction but the difference is not statistically significant at the 5 % significance level. Hence, depending on the store type, PIN card transactions seem to be either faster than cash transactions or equally time consuming as cash transactions. It is also worth noting that contactless card payments, which have quickly been gaining in popularity since their arrival in 2014 are even faster than PIN transactions with a median transaction time of 6,3 seconds and with a minimum transaction time in this sample of just 2,3 seconds.

Since most sources of potential bias presented above would bias the transaction time of cards upwards and the transaction time of cash downwards, meaning PIN card payments might be even faster than estimated and cash payments might be even slower than estimated, it seems quite reasonable to conclude that the assumptions of card transactions being time wise more costly than cash does not hold in Finland, not even for higher value purchases that cannot be made using the faster contactless technology.

### 5.4 Drivers of cash use in Finland

As (debit) cards (and cash) have never incurred transaction costs in Finland, the model of McAndrews and Wang (2012) that is based on pecuniary transaction costs does not

give much insight into how Finnish people make their payment instrument choice. Additionally, as card adoption rates have been very high for Finnish people at least since the millennium, people pay the fixed adoption and/or maintenance fees anyway, regardless of which instrument they use. Additionally, as cards have traditionally been free of any fees for people under 26 years of age, there are no card related costs that make cash cheaper for young people.

Before 2010's, when banks started to impose charges for cash withdrawals in excess of the four to five free withdrawals, cash withdrawals were free, and so acquiring cash did not cost anything, other than shoe-leather costs. Back then, however, cash incurred opportunity costs in the form of interest foregone and the risk of theft. In the 2010´s, depending on the withdrawal behaviour, cash withdrawals might incur small fees for some, but as they can easily be avoided by not making more than the amount of free withdrawals, they would probably still remain free for most. As the interest rates have been very low since the financial crisis in 2008, there is not much interest to forego. Shoe-leather costs and the risk of theft still exist though, although the risk of theft is relatively low in Finland. Still, it seems that if anything, cost wise cards have been and still are cheaper than cash, and they cannot explain why Finnish people would choose to use cash. Thus, models based on pecuniary costs related to cash and cards do not seem very relevant in explaining the payment instrument choice in Finland.

Additionally, as was shown in the transaction time study, PIN card transactions were equally fast or even faster than cash transactions in 2017, so, as it is likely that this has been the situation for some years already, the longer transaction time for cards cannot explain the choice between cash and cards either, at least not in 2016 when, according to the ECB cash study (Esselink and Hernandez, 2017) still 54% of all POS payments in Finland were made with cash. Thus, theories based on cards incurring time costs, such as those of Whitesell (1989) and Alvarez and Lippi (2017) do not seem relevant in the Finnish context.

Due to the high card adoption and acceptance rates in Finland, these are not likely to explain payment instrument choice either. The remaining explanations, offered by previous theoretical and empirical literature, include cash being easier to use, more secure, better for expenditure control and anonymous. Certain transaction specific characteristics such as transaction value, type of POS and cash at hand might also affect the payment instrument choice. Additionally, habit might be a driver of cash use, as repeated behaviour is usually habitual rather than intention-driven. Although certain demographic factors such as education, income and age tend to have explanatory power in regression analyses, it remains unclear what type of reasons they reflect. Next, I will use some data from Bank of Finland's 2016 cash study to examine whether these remaining factors seem to affect the payment instrument choice in Finland.

Bank of Finland conducts surveys on access to cash and the condition of cash in circulation at regular intervals. The survey often contains a few questions on cash use as well, such a question on the main instrument people use when making everyday purchases. The 2016 survey included, amongst other things, a question on the reasons for using cash. People were allowed to name several reasons. The target group of the survey was Finnish people aged 15 to 79 years, excluding the county of Åland. The data was collected by phone in January 2016. The sample was collected from the population register using random sampling and it included 503 persons. Weights to weight the sample according to age, gender, residential area and the size of the household were provided.

According to the cash study, 26 % of Finnish people choose cash because they consider it to be the best payment instrument to make small payments with, making it the most commonly sited reason (Chart 4).[11] The next most cited reason is that cards are not accepted everywhere (17 %), followed by having obtained cash from another person (12 %), cash helps control spending (9 %) and cash being fast and easy (9 %). Safety (3 %) and anonymity (1 %) were rarely mentioned. Looking at the reasons to use cash

[11] All percentages are calculated using weights to make them reflect the population shares. As people were able to mention more than one reason, shares within one group will not add up to 100%.

within specific cash user groups gives some interesting insight into the drivers of cash use.

Within those who make the majority of their everyday purchases with cash, that is, the cash preferers, the most important reason to use cash was the need to control spending (29 %), followed by finding cash fast and easy (28 %), and using cash out of habit (22 %). As has been shown previously, in Finland cash payments are not faster than PIN card payments, and contactless card payments clearly outperform cash in speed. It could even be argued that contactless card payments are not only faster but also easier than cash payments, as nothing more is needed than a quick swipe of the card near the payment terminal, whereas cash use includes searching for the right amount of notes and coins and/or handling the change. Therefore, the popularity of this reason seems a little odd. However, it could be that the cash preferer group contains a lot of those people who find inserting the PIN code difficult or arduous (which is what has to be done even with the contactless card payments from time to time).

Card preferers on the other hand, that is, those who make the majority of their everyday purchases with cards, use cash for small purchases (30 %), if cards are not accepted (22 %), if someone has given them cash (14%) or if they happen to have cash with them (9 %). As those who use cash for small value transactions seem to be mostly different people than those who use cash when cards are not accepted,[12] or when they have received cash from another person[13], it seems that there are two types of card preferers: those who probably always prefer to use cards and use cash only when they have to or when they have received it from someone else, and those who prefer to use cards most of the time but still want to use cash for small value transactions.

People with no preferences fall in between cash and card preferers, with them using cash mainly for small payments (24 %), to control overspending (18 %), out of habit (14

[12] Only 10 % of those who state using cash when cards are not accepted also use cash for small transactions.
[13] Only 11 % of those who use cash when they receive it from someone also state they use cash for small value purchases.

%), because cash payments are fast and easy (14 %) or because someone has given them cash (12 %). Thus, it seems that heavy cash use is mainly driven by the need to control overspending.

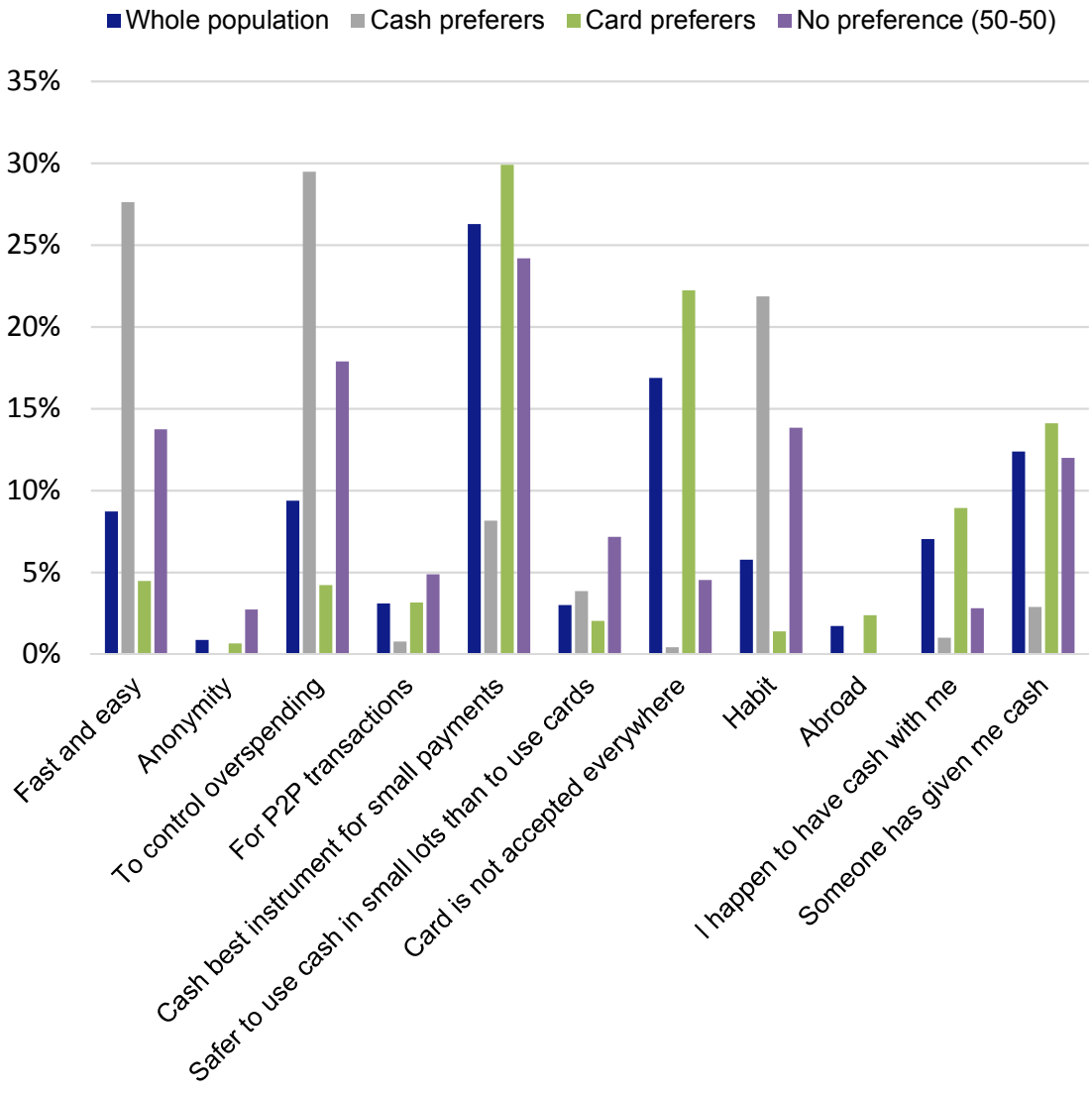
In conclusion, it seems that cash use in Finland is driven by the need to control spending, a preference to pay small transactions in cash, and perceiving cash easy (and fast). Although many card preferers state that they use cash because cards are not accepted everywhere, this does not necessarily mean this would happen often. Rather, as the card acceptance rate in Finland is very high as was shown by the ECB cash study (see Chart 3), it is likely, that this just reflects the fact that many Finnish people prefer to use cards for pretty much all of their transactions and they only use cash when they have no other option.

Although only 3 % of people cited to use cash because it is a good alternative for person to person transactions, many card preferers and people paying half of their purchases with cards stated that they use cash if they happen to get it from some other people. This suggests that, in parallel to people using cash if faced with no other option, there is another "involuntary" component of cash use in Finland: some do not withdraw cash themselves, but will use cash if they are given money in cash form.

As the cost structure and transaction times of cash and cards suggest that cards are, if not cheaper and faster, at least equally cheap and fast as cash transactions, they cannot explain cash use in Finland in 2016. Therefore considering cash to be the best instrument for small transactions seems a little puzzling. One potential explanation is that habit plays a role in this. As there used to be restrictions on card use for payments below 30 marks, it is possible that especially older people who became accustomed to this threshold value still pay smaller payments with cash out of habit, even though the restriction has been long gone. It is also possible, that as card transactions have probably been slower than cash transactions at least at some point in time, people might not have realised that cash is not the fastest payment instrument anymore, if they haven't specifically thought about it.

In addition to costs and transaction times, other factors that do not seem to explain cash use in Finland are safety concerns and anonymity. This is not very surprising as Finland is a relatively safe country and Finnish people have a relatively high trust in authorities (Eurobarometer, 2016).

## Chart 4. Reasons to pay with cash.




Source: 2016 Cash Study, Bank of Finland. Weighted to reflect the Finnish population aged between 15-79 according to age, gender, residential area and the size of the household.

## 5.5 Cash use in future

Using cash to pay small transactions was the most common reason for people to pay in cash in Finland in 2016. The popularity of contactless card payments has been increasing extremely fast ever since the first cards and terminals appeared in the first half of 2010's.[14] According to Bank of Finland's payments statistics (Bank of Finland (b)), the number of contactless card payments has increased from 3,55 millions in 2014 to 162,5 millions in 2016. Whether it is old conventions and habits, the belief that cash is faster than card payments, or the nuisance of inserting the PIN code every time a card transaction is made that has kept people from paying small transactions with card, the contactless card payments will probably transform the payment behaviour in this regard as they are remarkably faster than cash payments, specifically designed and marketed for small value transactions, and even most of the hassle with inserting the PIN code is avoided. Thus, perceiving cash the best alternative for small payments, especially amongst those people who otherwise prefer to use cards, will probably change in the near future and decrease cash use significantly.

Another new innovation, mobile phone applications for sending money to other private persons, will probably also have an effect on the cash use, as it is a lot faster and more convenient than cash and credit transfers which have traditionally been the only alternatives for making person-to-person transactions. The features making these applications relatively fast and easy are that as people tend to have their mobile phones always with them, these payment methods are not constrained by the amount of money people have with them and they do not need to remember any bank account numbers, as phone number of the recipient is enough (and usually already saved in the phone). Additionally, sending money through these applications mitigate the risk present with credit transfers of not receiving the payment, as with the new applications the recipient of the payment will usually immediately receive a notification on the incoming payment. Therefore, although not that many people indicated using cash due to it being convenient for person-to-person transactions,

[14] There have been cards with contactless payment possibilities and terminals accepting them in use at least since 2014, but I was not able to find more specific information on when exactly they were launched.

quite many indicated using cash if they have received some from other people. As the use of these applications becomes more common, cash receipts from other people will probably decrease, lowering the amount of cash used.

If cash use for small transactions and for person-to-person transactions decreases due to these new applications, the dominant reasons for making cash payments in Finland will probably be the need to control spending, habit (although the share of people who have the habit of paying small transactions with cash will probably decrease remarkably) and ease of use for those who find it tricky or unfamiliar to pay with cards. This could include, for example, old people who have difficulty in remembering the PIN or trouble learning how to use new technology. Although it is often considered that these type of consumers will disappear with time as the old people who never learned to use new technology die, it is likely that the problem doesn't disappear completely. Even though people were good with technology when young, ageing could bring problems with memory and it might become difficult to keep up with the constant technological change.

Although also expenditure control is an area where new type of applications providing, for example, real time information on account balances, help in managing the finances, or possibly even warnings when daily expenditure limits are reached, cash might not be fully substitutable by electronic alternatives, as tangible notes and coins might have a behaviour restricting effect that cannot be reached to the same degree by numbers or warning signs on an electronic device. Therefore, the need to control spending will probably remain a driving factor for cash use.

# 6. Conclusions

There has been a lot of discussion on the downsides of cash during the 2010's, and the new payment instrument innovations during this same decade have provoked speculation that cash use will decrease considerably, potentially even disappear, in the upcoming years. However, to my knowledge, no systematic reviews have been made to date on what drives cash use theoretically or empirically. Therefore, one of the main goals of this thesis was to fill these gaps by producing reviews on these two strands of literature. Additionally, I wanted to check the relevance of the theoretical models in view of the empirical findings.

As the retail payment markets differ remarkably between countries due to differences in infrastructure, costs and possibly the payment culture in general, and as the Nordic countries, although forerunners in electronic payments, have rarely been studied, I wanted to use Finland as an illustration to study the relevance of theoretical models and even the empirical findings in an environment where there should be practically no barriers to make all payments by electronic payment instruments, such as cards.

The theoretical models explaining the choice between cash and cards at points of sale are built on assumptions that the pecuniary and/or non-pecuniary costs of cash and cards use differ. Particularly, card transactions are assumed to incur higher time costs than cash transactions (Whitesell, 1989, and Alvarez and Lippi, 2017), cards are assumed to incur higher information processing and storing costs than cash (Von Kalckreuth et. al., 2014b), or it is assumed that cards become cheaper than cash only once certain expenditure level is obtained, due to cards incurring fixed adoption/maintenance costs and card only accepting merchants charging higher prices, while cash incurs pecuniary transaction costs higher than those of card (McAndrews and Wang, 2012). Of these costs, all other seem to reflect real life costs, except the assumptions of McAndrews and Wang that cash use incurs pecuniary transaction costs proportional to the value of transactions and that certain card accepting merchants would accept only card payments. Behaviour wise, cash use is associated with lower transaction value, lower income, higher amounts of cash in the

wallet and using cash to monitor liquidity. All models, except that of McAndrews and Wang (2012) seem plausible and can be considered as relevant in explaining payment instrument choice in many countries.

In empirical literature, factors that affect the payment instrument choice at point of sale are traditionally divided into four categories: payment instrument attributes, transaction specific characteristics, demographic factors and habit. Although the theoretical literature provided explanations for why people use cash for small value transactions, why cash burns, that is, why people tend to use cash if they have it in the pocket, why cash is better for people who want to control their expenditure and why people with lower income are more likely to use cash, the empirical literature provided also alternative explanations for the observed behaviour. For example, some of the negative correlation between cash use and transaction size could be due to people unconsciously spending more when they use cards, either because cash use has a restrictive effect on spending behaviour, or because when using card, one is not constrained by the amount cash one has in the wallet. The fact that cash is not only efficient for controlling overspending due to it facilitating monitoring the amount left to spend but also because it might have a behaviour restricting effect could also partly explain its popularity as a tool for expenditure control.

In addition to the drivers of cash use presented in theoretical literature, the empirical literature identifies several other drivers of cash use. These include perceiving cash easy to use and safe, making payments at certain type of stores, old age (to some degree), low level of education, and habit. Anonymity, although often considered as an advantage of cash, does not seem to explain cash use very well.

The psychological literature suggests that frequent actions, such as making payments, are mainly driven by habit rather than by intentional behaviour. Applying the theory in the context of payment instrument choice, it would mean that people probably initially make a cost benefit analysis on payment instrument attributes to make a choice. After a while, however, people would merely react to context cues instead of performing intentional behaviour. Here, context cues could be factors specific to a payment

situation, that is, factors such as the type of POS, the amount of money in the wallet and maybe even the transaction value. When asked about the reasons for behaviour some might identify they act out of habit while others do not and try to interpret the reasons by observing their behaviour. Sometimes valuations on attributes might change, for example a need for controlling overspending might arise, provoking new intentional behaviour and leading to changes in payment behaviour and in reasons driving it. Until habit takes over intention again. Although the effect of habit is difficult to disentangle from that of intentional behaviour, and some of the studies have weaknesses that make it difficult to draw any conclusions based on their evidence, I think the idea that habit drives payment behaviour at least to some degree does get enough support for the idea not to be rejected.

A considerable limitation of the existing literature is that it focuses solely on explaining and analysing cash use for transaction purposes at points of sale. However, cash is also used for person-to-person transactions and as a store of value, and the reasons for cash use probably differ a lot in these other two use cases.

Due to well-developed infrastructure, and cheap and fast card payments, many of the drivers of cash use identified by theoretical models and empirical evidence cannot explain cash use in Finland. In 2016 Finnish people used cash to pay small transactions, to control spending, because they perceived it to be easy to use, when they obtained it from another person or out of habit. Due to the quickly growing popularity of contactless card payments and the mobile phone applications for making easy person-to-person transactions it is likely that in future cash will decrease remarkably and it is mainly driven by the need to control spending, difficulty in using electronic payment instruments and habit.

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Appendix A. Studies included in the empirical literature review.

| Study | Publication year | Data collection year | Country | Type of data | Adoption versus usage decision | Includes bad controls |
|---|---|---|---|---|---|---|
| Payment instruments as perceived by consumers - results from a household survey - Jonker | 2007 | 2004 | The Netherlands | survey | Adoption and usage | |
| Consumer awareness and the use of payment media: Evidence from young Finnish consumers - Hyytinen & Takalo | 2009 | 2002 | Finland | survey | Usage | |
| Incentives at the counter: An empirical analysis of surcharging card payments and payment behaviour in the Netherlands.Bolt, Wilko & Jonker, Nicole & van Renselaar, Corry. | 2010 | 2006 | The Netherlands | - | Usage | |
| How do you pay? The role of incentives at the point-of-sale - Carlos Arango, Kim P. Huynh, Leonard Sabetti | 2011 | 2009 | Canada | payment diary (3 days) | Usage | yes |
| Security of retail payments: the new strategic objective - Joanna Stavins | 2013 | 2010 | The US | survey | Adoption and usage | |
| Why do shoppers use cash? Evidence from shopping diary data - Naoki Wakamori and Angelika Welte | 2012 | 2009 | Canada | payment diary (3 days) | Usage | |
| Payment Choice with Consumer Panel Data - Michael Cohen and Marc Rysman | 2013 | 2006-2008 | The US | scanner data (3 years) | Usage (includes both adopters and non-adopters) | |
| The safety of cash and debit cards: a study on the perception and behaviour of Dutch consumers - Anneke Kosse | 2013 | 2008 | The Netherlands | survey | Usage (includes both adopters and non-adopters) | |
| Choosing how to pay: the influence of foreign backgrounds - Anneke Kosse, David-Jan Jansen | 2013 | 2009 | The Netherlands | payment diary (1 day) | Adoption and usage | |
| Consumer Cash usage: A Cross-Country Comparison With Payment Diary Survey Data - John Bagnall, David Bounie, Kim P. Huynh, Anneke Kosse, Tobias Schmidt, Scott Schuh and Helmut Stix | 2014 | 2009, 2010, 2011, 2012 | The Netherlands, Canada, Austria, Germany France, Australia, the US | Payment diary (lenght varies by country) | Usage (includes both adopters and non-adopters) | yes |
| Choosing and using payment instruments: evidence from German microdata Ulf von Kalcreuth, Tobias Schmidt and Helmut Stix | 2014 | 2008 | Germany | payment diary (7 days) | Usage | yes |
| Using cash to monitor liquidity - implications for payments, currency demand and withdrawal behaviour - Ulf von Kalckreuth, Tobias Schmidt and Helmut Stix | 2014 | 2008 | Germany | payment diary (7 days) | Usage | yes |
| Cash versus debit card: the role of budget control - Lola Hernandez, Nicole Jonker and Anneke Kosse | 2014 | 2012 | The Netherlands | survey | Usage (includes both adopters and non-adopters) | |
| Changing payment patterns at point-of-sale: their drivers - Carin van der Cruijsen and Mirjam Plooij | 2015 | 2004 ja 2014 | The Netherlands | survey | Adoption and usage | |
| Why is cash (still) so entrenched? Insights from Canadian shopping diaries - Carlos A. Arango, Dylan Hogg and Alyssa Lee | 2015 | 2009 | Canada | payment diary (3 day) | Usage | yes |
| In love with the debit card but still married to cash - Carin van der Cruijsen , Lola Hernandez and Nicole Jonker | 2015 | 2013 | The Netherlands | payment diary (1 day) | Usage | |
| How people pay: Evidence from grocery store data - Elizabeth Klee | 2008 | 2001 | the US | scanner data (2 months) | Usage (includes both adopters and non-adopters) | |
| Payment Choice with Consumer Panel Data. Cohen, M., Rysman, M. & Wozniak, K. | 2018 | 2006-2008 | the US | scanner data (3 years) | Usage (includes both adopters and non-adopters) | |